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MODERN ARITHMETIC

INTERMEDIATE

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MODERN INTERMEDIATE ARITHMETIC

BY

BRUCE M. WATSON

FORMERLY SUPERINTENDENT OF SCHOOLS
SPOKANE, WASH.

AND

CHARLES E. WHITE

PRINCIPAL OF FRANKLIN SCHOOL
SYRACUSE, N.Y.

D. C. HEATH & CO., PUBLISHERS

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INTRODUCTION

THE attention of teachers is directed to the following considerations that have guided the authors in the preparation of this series of arithmetics:

1. Thoroughness in the Fundamentals.

The first aim has been to secure thoroughness and facility in the use of the four fundamental processes, common fractions, and decimals.

2. Choice of Applications.

Applications, a knowledge of which is a daily necessity to the mass of men and women in active life, have received greatest attention.

Applications that are of use only to people in special fields of activity, or in particular communities, have been treated in a separate group, where they may be drawn upon as needed.

Those applications that have become unnecessary by reason of changed social needs, and those that have never served any purpose, other than that of filling the pages of a textbook, have been omitted altogether.

3. Simplification of Processes.

The number of technical terms, definitions, cases, and special processes has been reduced to the minimum. Thoroughness in a few simple, direct, general processes has been made possible by this treatment.

4. Problems from Real Life.

The problem material is drawn from the life in which children and their parents are living to-day. It is within their knowledge or experience, and presents real, rather than imaginary situations.

5. Continuity of Plan.

There is a continuity of purpose running through the entire series. The attention of pupils should be called again and again to the recurrence of a familiar fact or principle in a new application.

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It is this characteristic that suggests the term *cumulative* as descriptive of the plan of the series.

6. Recognition of Differences in Ability of Children.

It is possible for all normal children to learn the fundamental facts of arithmetic. Some will learn them much more quickly than others. Some will be able to solve more difficult problems than others. The *Modern Arithmetics* furnish material adapted to these various grades of ability. It is as grievous an error to permit the stronger pupils to pass along by meeting merely the minimum requirement, as to expect the weaker ones to perform tasks beyond their ability.

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SUGGESTIONS TO TEACHERS

THE work of the fifth and sixth grades, by pretty general agreement throughout the country, embraces these topics:

1. All operations with integers.
2. Common fractions.
3. Decimals.
4. Common measurements.
5. Percentage, without special applications.

Besides practice in the mere elements and technique of these topics, it is expected that pupils will have enough practical applications to give them facility in the solution of common, everyday problems that are usually met by people in the ordinary walks of life.

Pupils should often be reminded that only a few principles need be mastered and that these few occur again and again during the arithmetic course, in new applications.

The absence of extended reductions, addition, subtraction, multiplication, and division of compound numbers is intentional. These operations are seldom used in real life. When children know the tables and are trained to visualize the conditions given in a problem, they should be able to make any simple one-step reduction that may be required.

Let "cases" and special processes be put aside, relying upon the simple statement of the problem in every case to indicate the solution.

The oral exercises should never be assigned for study outside the recitation period. These exercises, studied in class with the pupils, furnish the teacher's golden opportunity for teaching. If anything must be omitted, let it be the written rather than the oral exercises.

Teachers of these grades should know thoroughly the work of preceding grades, so that there may be no confusion on account of change of methods.

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MODERN ARITHMETIC

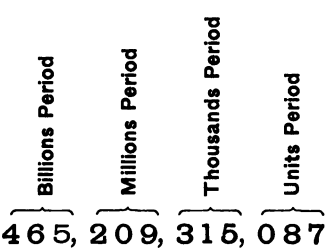
BOOK TWO—PART ONE

FIFTH GRADE

FIRST HALF

READING AND WRITING NUMBERS

IN the First Book, we used but few numbers that required more than six figures. Because larger numbers are sometimes used, we shall learn how to read and write them.



This number is read, *four hundred sixty-five billion, two hundred nine million, three hundred fifteen thousand, eighty-seven.*

A comma (,), sometimes called a **separatrix**, is used between periods to aid in reading numbers.

Oral

1. Name the periods in this number.
2. How many places are there in each period?
3. How many periods are there? How many places in all?

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Read these numbers:

In reading numbers avoid saying "and." For example, say "five hundred eighty-seven" — not "five hundred *and* eighty-seven."

1. 42,587	11. 183,649	21. 3,851,279
2. 4,298	12. 242,729	22. 76,983,972
3. 86,579	13. 407,593	23. 188,345,768
4. 70,407	14. 608,639	24. 429,503,106
5. 31,269	15. 301,301	25. 386,709,308
6. 20,030	16. 508,003	26. 406,831,211
7. 17,002	17. 196,005	27. 520,360,420
8. 40,600	18. 80,010	28. 200,300,500
9. 99,900	19. 398,000	29. 4,296,800,000
10. 10,010	20. 600,000	30. 45,300,705,810

Write these numbers in figures:

1. Fifty-one thousand, two hundred sixteen.

2. Seven hundred twenty-one thousand, two hundred.

3. Four million, six hundred eight thousand, three hundred seventy-five.

4. Twenty-five thousand, seven.

5. Twenty-seven million, six hundred fifty.

6. Eighty million, six hundred nine thousand, four hundred twenty-eight.

7. Six hundred twenty million, seventeen thousand.

8. One hundred fifty-seven million, six hundred eight thousand, four hundred seventy-seven.

9. Three billion, fifty-seven million, four hundred seventeen thousand, sixty.

10. Write a number containing three periods.

Practice writing numbers from dictation until it can be done rapidly without error.

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Roman Numerals

The chief uses of Roman Numerals are:

1. To number chapters in books.
2. To number headings.
3. To express dates on buildings, monuments, etc.
4. To number the hours on the clock face.

In Roman Numerals, these seven letters are used:

I (1), V (5), X (10), L (50), C (100), D (500), M (1000).

How the Letters Are Used

1. *Placing a letter after one of greater value adds its value to that of the greater.* X = 10, V = 5, XV = 10 + 5 = 15.

2. *Placing a letter before one of greater value subtracts its value from that of the greater.* V = 5, I = 1, IV = 5 − 1 = 4.

3. *Placing a letter between two letters of greater value subtracts its value from their sum.*

C = 100, L = 50, X = 10, CXL = 100 + 50 − 10 = 140.

4. *Repeating a letter repeats its value.*

X = 10, XXX = 10 + 10 + 10 = 30.

5. *Placing a bar over a letter multiplies the value of the letter by* 1000. D = 500, $\overline{\text{D}}$ = 500,000.

Numbers to One Hundred

1. I	6. VI	11. XI	16. XVI
2. II	7. VII	12. XII	17. XVII
3. III	8. VIII	13. XIII	18. XVIII
4. IV	9. IX	14. XIV	19. XIX
5. V	10. X	15. XV	20. XX

21. XXI. 22. XXII, etc. Continue these to XXIX.
30. XXX. 31. XXXI, etc. 40. XL. 60. LX.
70. LXX. 80. LXXX. 90. XC. 1919. MCMXIX.

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ADDITION

1. *Addends*

3		
5	64	
7	56	
2		
8	49	
6		
6	39	
5		
5	27	
9	17	
8		
64	*Sum*	

In adding a column, always look for combinations of two or more figures whose sum may be taken as an addend. Thus, in adding this column upward, say, "17, 27, 39, 49, 56, 64." In adding downward, say, "15, 25, etc."

Few people find it worth while to combine three figures, except at the beginning, as in adding this column downward, when we see at a glance that the sum of the first three figures is 15.

3		
5	15	
7		
2		
8	25	
6		
6	37	
5		
5	47	
9	56	
8	64	
64	*Sum*	

Add the following columns up and down, making combinations where possible. Practice until you get all sums correct in two minutes. Write only the sums. Do not copy addends.

2.	3.	4.	5.	6.	7.	8.
4	9	6	3	8	8	1
6	8	3	9	2	2	1
5	4	5	7	7	3	8
7	3	0	6	9	5	9
2	7	7	4	3	9	3
9	2	3	5	5	7	5
3	6	9	5	4	3	4
7	4	1	8	4	6	6
4	8	6	2	9	4	9

To THE TEACHER: Give much blackboard practice with single columns like these. In pointing, for individual or concert work with the class, run the pointer from bottom to top (or reverse) of a column by a *continuous* motion. Do not move the pointer from one figure to another, stopping each time. Point thus for individuals, letting class make corrections. Encourage children to run up and down columns with a pencil, gradually increasing their speed.

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Add, and test your work by adding downward:

1.	2.	3.	4.	5.
28	639	1050	126	$115.85
39	874	394	149	327.15
76	596	769	1260	495.27
42	421	564	1004	160.03
89	397	285	986	598.09
73	269	784	24	784.06

6.	7.	8.	9.	10.
97	857	283	$208.40	$356.24
98	943	2075	32.03	35.09
79	268	298	26.07	2.15
68	207	963	18.94	30.05
40	976	859	236.29	5.16
87	888	876	28.15	304.29

11.	12.	13.	14.
2673	837	628	8063
846	2964	4307	259
1025	418	526	8264
92	3825	8279	1287
837	842	428	428
642	29	4273	3064
4983	561	746	42379
8698	29	394	6507
2789	387	786	93289

15. Four thousand thirty; sixteen thousand two hundred forty-nine; ten thousand four hundred eighty-six; three hundred ninety-eight thousand fifty; eight hundred thousand seven hundred sixty-nine; sixty thousand seventy.

16. Five million, three hundred eighty-nine thousand, seventy-seven; ninety million, eight hundred six thousand, seventy-six; ninety thousand; three hundred forty-nine million; eighty-eight thousand thirty.

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Addition without a Pencil

Everybody ought to be able to add two numbers of two figures each, without using a pencil. Here is an easy way:

Add 25 *and* 47.

$25 + 40 = 65.$
$65 + 7 = 72.$ *Ans.*

Say 25, 65, 72.

Answer rapidly:

1.	$20 + 30$	2.	$40 + 40$	3.	$50 + 30$
4.	$60 + 20$	5.	$90 + 20$	6.	$70 + 20$
7.	$30 + 30$	8.	$70 + 30$	9.	$80 + 40$
10.	$20 + 38$	11.	$70 + 49$	12.	$80 + 73$
13.	$50 + 65$	14.	$82 + 40$	15.	$67 + 80$
16.	$\$.30 + \$.40$	17.	$\$.80 + \$.35$	18.	$\$.75 + \$.50$
19.	$29 + 26$	20.	$48 + 35$	21.	$79 + 76$
22.	$\$.25 + \$.36$	23.	$\$.76 + \$.21$	24.	$\$.36 + \$.80$
25.	$\$.92 + \$.31$	26.	$\$.85 + \$.66$	27.	$\$.72 + \$.43$
28.	$28 + 26$	29.	$62 + 28$	30.	$62 + 24$
31.	$42 + 75$	32.	$57 + 36$	33.	$65 + 34$
34.	$63 + 29$	35.	$72 + 29$	36.	$53 + 46$
37.	$27 + 38$	38.	$35 + 26$	39.	$64 + 44$
40.	$45 + 34$	41.	$44 + 38$	42.	$73 + 27$

43. 18 boys and 23 girls are how many pupils?

44. 39 boxes of Pippins and 56 boxes of Jonathans are how many boxes of apples?

45. Julian had 40 cents in his pocket and 93 cents in the bank. How much money had he?

46. Let each member of the class give two numbers for the next pupil to add, after adding those given him.

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SUBTRACTION

1. Mr. King had $8500 in the bank, and drew out $6937. How much had he left?

$8500	*Minuend*
$6937	*Subtrahend*
$1563	*Difference*

There are three ways in which the result may be found:

First way: Say, "7 from 10 = 3; 3 from 9 = 6; 9 from 14 = 5; 6 from 7 = 1."

Second way: Say, "7 from 10 = 3; 4 from 10 = 6; 10 from 15 = 5; 7 from 8 = 1."

Third way: Say "7 and 3 = 10; 4 and 6 = 10; 10 and 5 = 15; 7 and 1 = 8."

The third method, called the Austrian, is gaining in use. Choose one method and use it always.

To avoid confusion in problem work, we must remember that subtraction is *taking away*.

Since the difference is always the number that must be added to the subtrahend to make the minuend, it follows that subtraction may be tested by adding the subtrahend and difference. If the sum obtained is the minuend, the work is correct.

Subtract and test results:

1.	2819 674	2.	8203 1276	3.	4295 597	4.	7306 1807
5.	2763 1289	6.	37284 9287	7.	36801 18463	8.	18003 921
9.	92874 11392	10.	94210 8206	11.	42840 38706	12.	98301 26942

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Subtraction without a Pencil

Everybody should be able to subtract numbers of two figures each without using a pencil.

Here is an easy way:

From 83 take 57.

$83 - 50 = 33.$

$33 - 7 = 26.$ *Ans.*

Say 83, 33, 26.

NOTE. — This is not the "making change" method, for in making change we do not compute the amount received.

Answer rapidly:

1.	70 − 30	2.	90 − 20	3.	60 − 40
4.	86 − 20	5.	73 − 50	6.	69 − 30
7.	90 − 25	8.	80 − 37	9.	40 − 17
10.	58 − 33	11.	66 − 31	12.	79 − 45
13.	97 − 48	14.	58 − 39	15.	71 − 56
16.	38 − 19	17.	72 − 26	18.	63 − 25
19.	27 − 18	20.	66 − 37	21.	48 − 19
22.	42 − 15	23.	92 − 48	24.	51 − 27
25.	61 − 22	26.	87¢ − 39¢	27.	84¢ − 47¢
28.	\$.81 − \$.36	29.	\$.42 − \$.29	30.	\$.75 − \$.39

31. How much change is due in each case if one dollar is offered in payment for each of these purchases: 39¢; 48¢; 62¢; 79¢; 33¢; 29¢; 87¢; 62¢?

32. The sum of two numbers is 87. One of them is 49. What is the other?

33. What must be added to 45 to make 91?

34. What is gained by buying cloth at 47¢ a yard and selling it at 75¢ a yard?

35. John's heart beat 78 times a minute when he was well, but 130 times a minute during a severe illness. How much faster did the heart beat during illness than in health?

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Problems Using Addition and Subtraction

Oral

1. Jennie bought a skein of Shetland floss for 10 cents, 3 skeins of embroidery silk for 12 cents, and a pair of knitting needles for 10 cents. How much change should she receive from a 50-cent piece?

2. Albert has earned 15 cents, 25 cents, and 17 cents toward a pair of gloves that cost $1. How much more money must he obtain in order to pay for the gloves?

3. Helen, Howard, and Henry wanted a canoe that cost $47. They obtained $19 by renting their rowboat, their mother contributed $12, and their father the remainder of the price. How much did their father give?

Here are some "specials" for one day at the market:

10 lb. cane sugar	68¢	English walnuts, 1 lb.	17¢
½ gal. can maple syrup	64¢	Salad oil, per can	27¢
1 pint olive oil	57¢	5 boxes of matches	19¢
3 lb. navy beans	25¢	Olives per pint	15¢
Flour per sack	$1.75	Doughnuts per doz.	9¢

Find the cost of:

4. 10 lb. sugar and ½ gal. maple syrup.

5. 1 pt. olive oil and 5 boxes of matches.

6. A sack of flour and 1 lb. of English walnuts.

7. A sack of flour, a pint of olives, and 3 lb. navy beans.

8. A can of salad oil, 5 boxes of matches, and a pint of olives.

9. Five boxes of matches and a sack of flour.

10. 3 lb. navy beans, 1 pt. of olives, and 1 doz. doughnuts.

11. Let each pupil make a problem for the next pupil to solve.

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Written

1. The distance by rail from Galveston to San Antonio is 572 miles, from San Antonio to Tucson 932 miles, and from Tucson to Los Angeles 501 miles. What is the distance by rail from Galveston to Los Angeles?

2. Jessie bought sugar for 65 cents, tea for 55 cents, molasses for 72 cents, butter for 84 cents, and starch for 25 cents. She gave in payment a five-dollar bill. How much change should she receive?

3. A ship loaded with iron sailed from Cleveland to a port 332 miles west of that city. A car loaded with machinery at Cleveland was taken to a city 619 miles east of Cleveland. How far apart were the ship and the car when each had reached the end of its trip? (Illustrate.)

4. A train started from Chicago with 324 passengers. On the way to St. Paul 185 passengers left the train, and 149 came aboard. How many passengers were on the train when it reached St. Paul?

5. Two vessels start from points 850 miles apart and sail toward each other. How far apart are they when one has sailed 246 miles and the other 352 miles? (Illustrate.)

6. John's father gave him $2.25, and his uncle gave him $1.40. He earned enough besides so that he could buy a suit of clothes for $8. How much did he earn?

7. John sold 62 newspapers, Frank 48, and Henry 27 less than both of them. How many did Henry sell?

8. A grocer bought three barrels of apples for $6.50, a box of lemons for $2.70, and three barrels of flour for $24.90. He paid for them with two gold pieces and received $5.90 change. What were the gold pieces?

9. The sum of 3 numbers is 100. Two of them are 29 and 37. What is the other?

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MULTIPLICATION

It is unsafe to assume that all pupils in the fifth grade know the multiplication table. Some of them may not have had the thorough practice exercises of the first book. Some have been absent. Some may have forgotten, particularly after vacation.

The simple device given below will serve to test the class on all multiplication combinations to 12×12. Let five minutes at the beginning of each arithmetic period be devoted to testing the class on multiplication combinations. Keep a record sheet containing the names of all members of the class in a column. After each name, note the combinations missed by that pupil, in the test, so that he may give those combinations special attention. As soon as a pupil has made a perfect test, let him be enrolled in the "One Hundred Club" whose members are given some special privilege.

ORAL EXERCISES

(Reviewing work of primary arithmetic)

3	4	5	2	6	1	8	0	7	12	10	11	9
7	12	9	0	11	5	10	4	1	3	6	2	8

1. Multiply every number in the upper line by each number in the lower line.
2. How do we multiply a number by 10? By 100? By 1000?
3. Multiply 7 by 10; by 100; by 1000.
4. Multiply 34 by 10; by 100; by 1000.
5. Multiply 11 by 3; by 30; by 300.
6. Multiply 12 by 7; by 70; by 7000.
7. The product is a multiple of the multiplicand. Of what other number is it a multiple?
8. Of what number is 33 a multiple?
9. Name 5 divisors of 24.
10. Multiply 23 by 12.

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11. Multiply 23 by 10, also by 2. Add the two products. How does this result compare with the answer to question 10?

12. Multiply 30 by 5, then by 20. Add the two products. The sum is how many times 30?

13. 90 times 48, added to 6 times 48, are how many times 48?

14. 500 times 786, 40 times 786, and 3 times 786, added, make how many times 786?

Give the products at sight:

15. 86 × 7	**16.** 307 × 5	**17.** 315 × 10	**18.** 73 × 100	**19.** 32 × 20
20. 14 × 30	**21.** 28 × 200	**22.** 25 × 300	**23.** 16 × 700	**24.** 28 × 1000
25. 75 × 2000	**26.** 103 × 40	**27.** 212 × 50	**28.** 31 × 400	**29.** 205 × 600

THE MULTIPLICATION TABLE

$2 \times 1 = 2$ $2 \times 2 = 4$ $2 \times 3 = 6$ $2 \times 4 = 8$ $2 \times 5 = 10$ $2 \times 6 = 12$ $2 \times 7 = 14$ $2 \times 8 = 16$ $2 \times 9 = 18$	$3 \times 1 = 3$ $3 \times 2 = 6$ $3 \times 3 = 9$ $3 \times 4 = 12$ $3 \times 5 = 15$ $3 \times 6 = 18$ $3 \times 7 = 21$ $3 \times 8 = 24$ $3 \times 9 = 27$	$4 \times 1 = 4$ $4 \times 2 = 8$ $4 \times 3 = 12$ $4 \times 4 = 16$ $4 \times 5 = 20$ $4 \times 6 = 24$ $4 \times 7 = 28$ $4 \times 8 = 32$ $4 \times 9 = 36$	$5 \times 1 = 5$ $5 \times 2 = 10$ $5 \times 3 = 15$ $5 \times 4 = 20$ $5 \times 5 = 25$ $5 \times 6 = 30$ $5 \times 7 = 35$ $5 \times 8 = 40$ $5 \times 9 = 45$
$6 \times 1 = 6$ $6 \times 2 = 12$ $6 \times 3 = 18$ $6 \times 4 = 24$ $6 \times 5 = 30$ $6 \times 6 = 36$ $6 \times 7 = 42$ $6 \times 8 = 48$ $6 \times 9 = 54$	$7 \times 1 = 7$ $7 \times 2 = 14$ $7 \times 3 = 21$ $7 \times 4 = 28$ $7 \times 5 = 35$ $7 \times 6 = 42$ $7 \times 7 = 49$ $7 \times 8 = 56$ $7 \times 9 = 63$	$8 \times 1 = 8$ $8 \times 2 = 16$ $8 \times 3 = 24$ $8 \times 4 = 32$ $8 \times 5 = 40$ $8 \times 6 = 48$ $8 \times 7 = 56$ $8 \times 8 = 64$ $8 \times 9 = 72$	$9 \times 1 = 9$ $9 \times 2 = 18$ $9 \times 3 = 27$ $9 \times 4 = 36$ $9 \times 5 = 45$ $9 \times 6 = 54$ $9 \times 7 = 63$ $9 \times 8 = 72$ $9 \times 9 = 81$

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Mr. Lanning bought 48 automobiles at $937 apiece. How much did he pay for them?

$937	*Multiplicand*
48	*Multiplier*
7496	
3748	
$44976	*Product*

We first take 8 times 937, then 40 times 937, and add the results. Notice that 40 times 937 is 37480. We omit the cipher, because it makes no difference in the product.

Examples for Practice

1. 937×64	6. 398×48	11. 4964×38
2. 842×29	7. 489×35	12. 8765×42
3. 649×83	8. 359×85	13. 9243×99
4. 897×85	9. 468×31	14. 6835×87
5. 408×96	10. 819×19	15. 8937×46

16.

429	567
567	429
3003	5103
2574	1134
2145	2268
243243	243243

When we multiply 429 by 567 and 567 by 429, how do the products compare? Multiply 38 by 17 and 17 by 38 and compare the products. Find $2 \times 6 \times 9$. Find $2 \times 9 \times 6$. Find $9 \times 2 \times 6$. Compare the products.

The multiplicand and multiplier are **factors of the product.**

The product is the same in whatever order the factors are taken.

In examples **17–28** find the products, and test each by multiplying again with the factors interchanged.

17. 436×815	20. 385×435	23. 435×218	26. 924×376
18. 329×248	21. 522×648	24. 625×842	27. 435×258
19. 695×867	22. 815×239	25. 393×475	28. 941×879

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1. 4.25×507

$$\begin{array}{r} \$4.25 \\ 507 \\ \hline 2975 \\ 2125 \\ \hline \$2154.75 \end{array}$$

In examples **1** and **2**, notice that the right-hand figure of each partial product is written directly under the figure of the multiplier used in obtaining it.

Ciphers at the right of the multiplier are merely brought down in the product, because annexing a cipher multiplies by ten.

If there are cents in either factor, there are cents in the product.

2. 739×5800

$$\begin{array}{r} 739 \\ 5800 \\ \hline 5912 \\ 3695 \\ \hline 4286200 \end{array}$$

Examples for Practice

3.	238×307	**21.**	493×60	**39.**	$\$16.25 \times 37$
4.	5126×208	**22.**	847×90	**40.**	$\$4.83 \times 25$
5.	485×304	**23.**	406×80	**41.**	$\$8.29 \times 33$
6.	796×509	**24.**	39×9000	**42.**	$\$6.08 \times 49$
7.	635×803	**25.**	42×800	**43.**	$\$7.25 \times 82$
8.	449×605	**26.**	38×380	**44.**	$\$6.39 \times 75$
9.	703×408	**27.**	42×610	**45.**	$\$.98 \times 307$
10.	905×386	**28.**	81×2300	**46.**	$\$.49 \times 205$
11.	729×409	**29.**	428×690	**47.**	$\$1.20 \times 356$
12.	305×892	**30.**	342×8500	**48.**	$\$8.65 \times 209$
13.	429×391	**31.**	855×4800	**49.**	$\$.69 \times 315$
14.	608×753	**32.**	429×3600	**50.**	$\$82.01 \times 208$
15.	428×869	**33.**	519×8100	**51.**	$\$3.91 \times 45$
16.	273×608	**34.**	316×8420	**52.**	$\$20.20 \times 80$
17.	488×909	**35.**	491×850	**53.**	$\$6.13 \times 700$
18.	369×406	**36.**	405×830	**54.**	$\$324 \times 5200$
19.	218×908	**37.**	625×490	**55.**	$\$4.07 \times 83$
20.	532×807	**38.**	836×250	**56.**	$\$9.10 \times 650$

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BUSINESS PROBLEMS

1. 25,079 crates of strawberries, each containing 36 quarts, were shipped from the city of Oswego in one season. What were they worth at 8 cents a quart?

2. What is the value of 47 barrels of shredded cocoanut, each containing 105 pounds, at 18 cents a pound?

3. (*a*) If it costs $4.78 a day to support your family, how much does it cost for a month of 31 days? (*b*) How much does it cost for a month of 28 days? (*c*) How much does it cost for a year?

4. There are 16 ounces in a pound. One ounce of rolled oats, when cooked, will serve one person.

a. At that rate, how many persons can a restaurant keeper serve with a purchase of 75 pounds of oatmeal?

b. If he charges 15¢ for each dish of oatmeal, how much does he receive for a pound of oatmeal?

5. A manufacturer put up 13 tons of cereal in sample packages, each containing 1 ounce. How many packages did he make?

6. *a*. Our school bought a $60 Victrola, 4 records at 75¢ each, two at $1.60 each, and one at $2.80. How much did we pay for all?

b. Money was raised in the different grades toward paying for the Victrola and records as follows: Eighth, $5.47; seventh, $8.29; sixth, $4.83; fifth, $3.68; fourth, $2.86; third, $3.97; second, $1.86; first, $1.75. The teachers and janitor gave $12.50, and the Neighborhood Club paid the balance. How much did the Neighborhood Club pay?

7. Mr. Ford's automobile consumed 496 gallons of gasoline during the year 1917. If a gallon of gasoline was sufficient for 19 miles' travel, how far did the car travel during that year?

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PRODUCT AND FACTORS

FOR TEACHERS. — The whole subject of arithmetic becomes easy for the pupil as soon as he sees clearly the relation of product and factors. Multiplication and division represent merely converse forms of this relation. They should appear to the pupil as one fact.

Multiplication is the process by which the product is found when its factors are known; division is the process by which one factor is found when the other factor and the product are known; thus,

$3 \times 2 = 6$ (multiplication); $3 \times ? = 6$, or $? \times 2 = 6$ (division).

Multiplication is the synthetic form of this relation; division is the analytic form. Multiplication is putting together; division is taking apart. In division, a product is given. Every product presupposes a previous multiplication; therefore every division presupposes a previous multiplication. Therefore, the most natural form for a child's visualization of a division problem is $a \times ? = ab$, or $? \times b = ab$.

This idea has been presented informally to the child many times in the first book of this series. It should now be presented formally and thoroughly. It is fundamental, and, when once appreciated, unlocks the door to every arithmetical problem involving either or both of these operations. It simplifies fractions, decimals, percentage, and all their applications.

Product and Factors

When two factors are given, we *multiply* either one by the other to find their *product.*

E.g. 8 and 9 are factors of 72; $8 \times 9 = 72$, or $9 \times 8 = 72$.

When a *product* and *one of its factors* are given, we divide the product by the given factor to find the *other factor.*

E.g. $8 \times ? = 72$; $72 \div 8 = 9$. *Ans.*
$? \times 9 = 72$; $72 \div 9 = 8$. *Ans.*

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Oral

1. 6 oranges at 3 cents apiece cost 18 cents. Which of these numbers is a product? Which are factors? When 18 and 6 are given, how can 3 be found? When 18 and 3 are given, how can 6 be found? When 3 and 6 are given, by what operation can 18 be found?

2. The area of a page of Henry's book is 35 square inches. If the length is 7 inches, what must be the width? If the width is 5 inches, what must be the length? 35 is which term in division? 35 is what of 5 and 7?

3. There are 9 square feet in 1 square yard. How many square yards are there in 108 square feet? 108 is the product of 9 and what other number? 108 is which term in division? 108 is what of 9 and 12?

4. Fred paid 54 cents for some sugar. The number of cents that a pound cost is one factor of 54. What is the other factor? What, besides 54 cents, must be given in order that we may find the cost of one pound? What, besides 54 cents, must be given in order that we may find the number of pounds that Fred bought?

Find:

5. The number of feet in 132 inches.

6. The number of pecks in 72 quarts.

7. The cost of a month's rent at $120 a year.

8. The number of weeks in 77 days.

9. The price of a lawn mower, when 15 lawn mowers cost $150.

10. Lester's wages per week, when he earns $40 in 8 weeks.

11. The cost of a pound of candy when three pounds cost 90 cents.

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DIVISION

The first number in each line below is a factor of every number in the line. Find the other factor of each number:

12. 5: 15; 75; 355; 525; 405

13. 7: 84; 217; 280; 763; 497

14. 11: 110; 44; 121; 880; 2211

15. 9: 819; 945; 189; 360; 963

16. 8: 64; 328; 176; 728; 960

In the following statements tell which numbers are factors and which are products:

17. There are —— peaches in 7 baskets if each basket contains 12 peaches.

18. 12 quarts of berries at —— cents a quart cost 96 cents.

19. Jerome's wages for 9 weeks at $—— a week amounted to $27.

20. 6 fountain pens at $3 apiece cost $——.

21. $1 will pay 20 carfares at —— apiece.

22. 72 cents will buy 12 pounds of sugar at —— cents a pound.

Division is *finding one of two factors, when the other factor and the product are given.*

In division, the given product is sometimes called the **dividend,** *the given factor* the **divisor,** and *the factor to be found,* the **quotient.**

When the divisor is not exactly contained in the dividend, the *part of the dividend that is left* is called the **remainder.**

E.g. 59 ÷ 8 = 7 *quotient,* and 3 *remainder.*

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Short Division

1. Our grocer bought 1748 sacks of flour. A barrel of flour fills four sacks. How many barrels of flour did he buy?

437 barrels. *Ans.*

4)1748

We say: 4 in 17, 4 times and 1 over.
4 in 14, 3 times and 2 over.
4 in 28, 7 times.

TEST

437
4
1748

Since the dividend is the product of the divisor and quotient, we may test our division by multiplying the quotient by the divisor. If this product equals the dividend, the division is correct.

2. $1239\frac{6}{7}$ *Quotient*

7)8679

Here is a remainder of 6, which cannot be exactly divided by 7. We place it over the divisor to *indicate* the division.

TEST

1239
7
8673
6
8679

The whole number in the quotient is multiplied by the divisor, and the remainder added, to obtain the dividend.

Divide, and test each answer:

3.	3756 ÷ 2	12.	28,343 ÷ 7	21.	4,986 ÷ 9
4.	8562 ÷ 3	13.	59,840 ÷ 4	22.	35,621 ÷ 7
5.	7506 ÷ 3	14.	12,358 ÷ 2	23.	42,963 ÷ 6
6.	3975 ÷ 5	15.	58,345 ÷ 5	24.	50,725 ÷ 3
7.	2835 ÷ 7	16.	11,007 ÷ 9	25.	93,043 ÷ 7
8.	3504 ÷ 8	17.	13,696 ÷ 4	26.	65,407 ÷ 5
9.	2009 ÷ 7	18.	29,365 ÷ 7	27.	39,842 ÷ 9
10.	1938 ÷ 9	19.	98,346 ÷ 6	28.	21,638 ÷ 8
11.	6432 ÷ 8	20.	30,005 ÷ 5	29.	45,428 ÷ 7

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Long Division

1.
$$41\overline{)33989}\quad 829$$
328
118
82
369
369

Quotient

In the examples on page 19 the quotients were obtained by **short division**, so called because the multiplication and subtraction were performed mentally.

Where the divisor is greater than 12, **long division**, expressing all of the work, is easier.

2.
$$49\overline{)10192}\quad 208$$
98
392
392

In this example, after 9 of the dividend was brought down, 39 would not contain 49, and 0 was written in the quotient. Then 2 was brought down.

Memorize these steps in long division:

I. Divide	IV. Subtract
II. Write quotient figure	V. Bring down
III. Multiply	VI. Repeat

Find the quotients, and test your work:

3. 20,213 ÷ 41	**15.** 112,197 ÷ 231	**27.** $338.25 ÷ 41
4. 34,578 ÷ 51	**16.** 635,773 ÷ 791	**28.** $65.66 ÷ 67
5. 51,832 ÷ 62	**17.** 98,230 ÷ 235	**29.** $91.84 ÷ 82
6. 9,372 ÷ 33	**18.** 135,248 ÷ 316	**30.** $73.96 ÷ 86
7. 38,364 ÷ 92	**19.** 348,552 ÷ 423	**31.** $33.35 ÷ 23
8. 13,950 ÷ 75	**20.** 635,773 ÷ 803	**32.** $32.22 ÷ 18
9. 35,244 ÷ 99	**21.** 110,889 ÷ 999	**33.** $102.79 ÷ 19
10. 55,232 ÷ 64	**22.** 272,688 ÷ 437	**34.** $185.31 ÷ 213
11. 11,043 ÷ 27	**23.** 272,688 ÷ 624	**35.** $73.44 ÷ 24
12. 22,770 ÷ 45	**24.** 580,110 ÷ 634	**36.** $53.90 ÷ 14
13. 33,235 ÷ 85	**25.** 81,263 ÷ 247	**37.** $50.19 ÷ 21
14. 26,796 ÷ 58	**26.** 94,605 ÷ 901	**38.** $289.80 ÷ 36

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PROBLEMS OF THRIFT

Oral

1. Elmer works for $5 a week and spends $2. Howard works for $6 a week and spends $4. Which boy has more money at the end of 12 weeks, and how much more?

2. Mr. Taylor gave Ethel an allowance of 50 cents a week and Martha 40 cents. Martha used 30 cents a week all the year, and saved the rest for Christmas. How much had she saved by Christmas? Ten weeks before Christmas, Ethel began saving all but 15 cents of her money each week. How much did she have at Christmas?

3. Mrs. Boggs buys cereal in two-pound packages, paying 25 cents a package. How much does she pay for 20 pounds? (20 lb. is 10 times 2 lb.) Mrs. Beaver buys the same kind of cereal in a 10-pound sack for 60 cents. How much does she pay for 20 pounds? How much more does Mrs. Boggs pay for ten pounds than does Mrs. Beaver?

Written

1. Mrs. Harris takes her four children to the "movies" twice a week, paying ten cents admission and ten cents carfare for each member of the family. How much does she spend in that way in a year? If the family had played games at home, saved the money, and bought a Victrola for $30, how many choice records at $2.00 each could they have bought with the money that was left?

2. Dorothy is 16 years old. She needed a new coat, but found that a well-made coat of good material would cost $22.50. She wore her old coat till late in the season and then bought a suitable coat for $7.79. How much did she save by waiting?

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In a western city, 3560 school children were enrolled in the Home Garden Club in one year.

3. If the sizes of their gardens averaged 2 square rods, and there are 160 square rods in an acre, how many gardens would an acre of ground make?

4. How many acres of ground were there in all the gardens?

5. If the average value of vegetables and flowers per garden was $7.39, what was the value of the produce (*a*) from one acre; (*b*) from all the gardens?

6. The Children's Market was conducted in a store down town for nine Saturdays during the season. The average sales for a Saturday were $47.93. What was the total amount of sales?

7. One girl's sales for the nine Saturdays were as follows: $2.15; $.98; $4.29; $3.17; $1.58; $3.75; $5.08; $3.45; $4.26. What was the total of her sales?

8. On one Saturday the sales were: Vegetables, $32.45; flowers, $5.16; eggs, 23 doz. at 34¢; poultry, $8.96; baked food, $9.48. What was the total for that day?

9. If a boy saves 50 cents a week for forty weeks each year during his school years in grades five to twelve, and also saves forty dollars from his earnings in each of the eight summer vacations, how much will he have to begin college with, adding $9.60 for interest earned at the bank?

10. In September, Hazel wanted a hat that was marked $2.80. Her mother waited until November and bought it at half price. How much did she save by waiting?

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CIPHERS AT THE RIGHT

PRINCIPLES

1. *Each removal of a figure one place to the left* **increases** *its value tenfold.*

E.g. $5 = 5$; $50 = 5 \times 10$; $500 = 50 \times 10$.

2. *Each removal of a figure one place to the right* **diminishes** *its value tenfold.*

E.g. $500 \div 10 = 50$; $50 \div 10 = 5$.

Oral

1. What is the shortest way to multiply by 10? By 100? By 1000? By 10,000? By 1 with any number of ciphers annexed?

2. $8 \times 10 = ?$ $8 \times 100 = ?$ $8 \times 1000 = ?$ $8 \times 10{,}000 = ?$

3. Cutting off a cipher from the right of a number is the same as moving all the figures one place to the right. How does it affect the value of the number?

4. How many ciphers must be cut from the right of a number to divide the number exactly by 100? By 1000?

5. Divide each of these numbers by 10:
50; 600; 5290; 36,000; 4500; 321,560.

6. Divide each of these numbers by 100:
300; 4500; 6000; 78,000; 70,000; 831,000.

7. Multiply each of these numbers by 10 and 1000:
7; 61; 20; 310; 402; 910; 653; 1020.

Written

1. Multiply 287 by 3700.

$$\begin{array}{r} 287 \\ 3700 \\ \hline 2009 \\ 861 \\ \hline 1061900 \end{array}$$ *Product*

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2. Divide 435,600 by 1800.

$$
\begin{array}{r}
242 \text{ } \textit{Quotient} \\
1800\overline{)435600} \\
\underline{36} \\
75 \\
\underline{72} \\
36 \\
36
\end{array}
$$

1800 = 18 × 100.
Therefore we divide by 100 and then by 18.
How do we divide by 100?

3. Divide 83,648 by 13,000.

$$
\begin{array}{r}
6\frac{5648}{13000} \text{ } \textit{Quotient} \\
13000\overline{)83648} \\
\underline{78} \\
5
\end{array}
$$

When we divide by 1000, there is a remainder of 648. When we divide by 13, there is a remainder of 5 in thousands' place. 5000 + 648 = 5648, whole remainder.

Multiply and test by dividing the product by the multiplier:

4. 432 by 20,100
5. 69 by 38,000
6. 420 by 80,000
7. 1242 by 3020
8. 5003 by 960
9. 208 by 6500
10. 320 by 420
11. 86 by 12,000
12. 409 by 30,800
13. 6900 by 413

Divide and test results:

14. 57,830 by 590
15. 4410 by 70
16. 34,376 by 100
17. 33,800 by 1900
18. 8580 by 260
19. 2400 by 3600
20. 42,978 by 300
21. 2359 by 470
22. 5900 by 4200
23. 7298 by 1600
24. 8700 by 3600
25. 6789 by 420
26. 5060 by 3090
27. 67,059 by 7800
28. 79,600 by 71,000
29. 80,700 by 3210

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Problems for Practice

Oral

1. How many fish did Frank catch in three days if he caught 9 the first day, 8 the second, and 12 the third?

2. In what time will a boy earn as much at $3 a week as a man earns in 6 weeks at $8 a week?

3. Nell is 3 years old and Will 5. Their sister's age is twice the sum of their ages. What is the sister's age?

4. How many gallons of milk will a family use in the month of June if it uses 2 quarts a day?

5. Frank rides 6 miles an hour and Albert 9. (*a*) How far apart will they be in 6 hours if they start at the same time and place and ride in the same direction? (*b*) If they ride in opposite directions?

6. Grace bought 2 dozen lemons. She used $\frac{3}{8}$ of them for lemonade and gave away 6. How many remained?

7. Helen bought $\frac{7}{8}$ of a yard of cambric. She used half a yard in her dress and wasted $\frac{1}{8}$ of a yard in cutting. How much was left?

8. A man owed $96. He made 5 payments of $12 each. How much did he then owe?

9. Luther earned $4 for the Y. M. C. A. War Fund, and his brother earned three times as much. How much did both earn?

10. $18 plus $12 is how much less than 4 times $12?

11. The product is 125 and one of the factors is 5. What is the other factor?

12. The divisor is 11, the quotient 12, and the remainder 9. What is the dividend?

13. The dividend is 85, the quotient 9, and the remainder 4. What is the divisor?

14. Let each pupil make a problem for the next to solve.

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Written

1. Three boys went fishing. They caught 16 perch, 27 trout, 19 pickerel, and 8 black bass. How many fish did they catch in all?

2. Margaret wants a $3 tennis racquet, two 40-cent tennis balls, and a 75-cent pair of tennis shoes. She has saved $3.45. How much more must she save?

3. The first Thanksgiving was in 1621 and the day has been observed every year since. How many times has the day been observed?

4. A father and his three sons earned $2461 in a year. The first son earned $676, the second $456, and the father $1080. How much did the third son earn?

5. The sum of three numbers is 342. Two of the numbers are 84 and 96. What is the third number?

6. A man had $1386 in the bank. During one week, he put into the bank $687, drew out $489, put in $248, drew out $298. How much had he in the bank at the end of the week?

7. A farmer had 46 acres of alfalfa. He cut three crops a year. The first crop yielded $1\frac{3}{4}$ tons per acre, the second $1\frac{1}{4}$ tons, and the third 1 ton.

a. How much was it worth at $8 a ton?

b. How many pounds of alfalfa did he obtain?

8. Frank earned $10 by working Saturdays. He bought a ball for $1.25, a mitt for $1.75, a bat for 75¢ and a mask for $2.35. How much had he left?

9. Mr. Paine traveled from Seattle to New York in five days. His railroad fare was $68.90, his Pullman tickets $17, his meals $2.25 a day, and his other expenses $4.25. How much did he have left from six $20 bills?

10. Find the cost of $5\frac{1}{2}$ yd. of serge at $1 a yard, $\frac{1}{2}$ doz. snaps at 10¢ a dozen, 1 pattern at 20¢.

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SEEING RELATIONS

Oral

FIG. A.

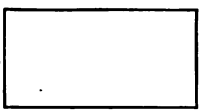
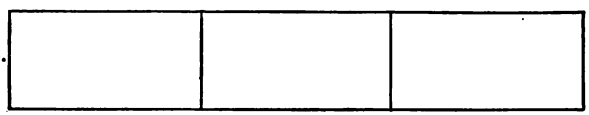


FIG. B.



1. Figure B is how many times as large as figure A?

2. If figure A is 1 inch long, how long is figure B?

3. If A and B are pieces of cloth, and A is worth $5, what is B worth?

4. If A is a piece of land containing 10 acres, what is B?

5. If A is a piece of land worth $12, what is B worth?

6. If B is worth $60, what is A worth?

7. If A and B are blocks of wood and A weighs 9 pounds, what does B weigh?

8. If B weighs 39 ounces, what does A weigh?

9. If A and B are fields, and A can be plowed in 4 days, how long will it take to plow B?

10. *a.* 10 pears are how many times 2 pears?

b. If 2 pears cost 3 cents, 10 pears cost —— cents.

c. 2 pears are what part of 10 pears?

d. Two pears are worth —— cents, when 10 pears are worth 25 cents.

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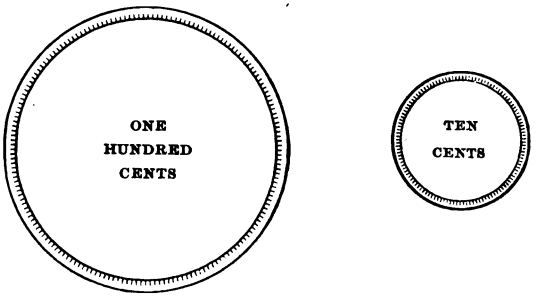

11. *a.* One dollar is how many times one dime?

b. One dime is what part of one dollar?

c. If one dollar will buy 30 pencils, one dime will buy —— pencils.

d. If one dollar will pay for 70 apples, one dime will pay for —— apples.

e. Frank can earn one dollar in —— hours if he can earn one dime in two hours.

f. If one silver dollar weighs one ounce, one silver dime weighs —— ounce.

12. If John rides 9 miles in 2 hours, in what time can he ride 27 miles at the same rate?

Analysis: 27 miles are 3 times 9 miles. Therefore, if John rides 9 miles in two hours, he can ride 27 miles in 3 times two hours, or —— hours.

Analyze each of the following problems:

13. If a man's wages for 12 hours are 5 dollars, in how many hours will he earn $20?

14. If 7 yards of cloth will make 2 suits, how many yards are required for 8 such suits?

15. When 75¢ will buy 6 pineapples, how much should be paid for 2 pineapples?

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Review and Practice in Whole Numbers

Oral

1. If a five-cent loaf weighs 12 ounces, how much should a 10-cent loaf weigh?

2. Eric received 20 cents for 3 hours' work. At that rate what should he receive for 12 hours' work?

3. The sum of two numbers is 28. One of the numbers is 16. What is the other?

4. 20 is how much more than 11?

5. Clara used 6 cups of flour in making 70 cookies. How many cups of flour should she use for 35 cookies?

6. Three eggs are used in making 50 doughnuts. One dozen eggs would be enough for how many doughnuts?

7. Albert feeds his horse 32 quarts of grain in three days. At the same rate, how many quarts does he feed the horse in 30 days? (30 is how many times 3?)

8. What is the cost of 50 five-cent stamps?

9. $25 \times 10 = ?$ $37 \times 100 = ?$ $16 \times 200 = ?$ $108 \times 400 = ?$

10. 96 is the product of 8 and what other number?

Written

1. Willis has 15 hens. They laid at the rate of 120 eggs apiece in one year. How many eggs were laid by all of them?

2. The food for the hens cost $21. Willis sold the eggs at an average price of 22 cents a dozen. How much more did he receive for the eggs than he paid for the food for the hens?

3. What was the profit from one hen?

4. What would be the profit from 75 hens at the same rate?

5. Willis has a rectangular hen park 30 ft. long and 15 ft. wide. How many feet of wire netting will inclose it?

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Problems of Carrying the Mail

1. A rural mail carrier works 298 days in a year and rides 24 miles each day. How far does he ride in a year?

2. He starts at 8.15 A.M. and returns home at 3.15 P.M. every day. How many hours does he spend on the road in a year?

He handled mail during one month as follows:

	Delivered	Collected
Registered Letters	5	3
Common Letters	1764	877
Postal Cards	436	297
Newspapers	4368	27
Circulars	507	0
Packages	105	26

3. The total number of pieces delivered was how much greater than the number collected?

4. If there were 189 families on this route, what was the average number of pieces delivered to each family?

5. If this carrier's salary is $900 a year, and it costs him $16 a month to keep his horse, how much of the salary is left to pay him for his year's work?

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FACTORS AND MULTIPLES

1. $2 \times 3 = ?$ $2 \times 5 = ?$ $2 \times 3 \times 5 = ?$
2. What must be done with 2 and 3 to obtain 6?
3. With 2 and 5 to obtain 10?
4. With 2, 3, and 5 to obtain 30?

The numbers that are multiplied to produce a number are **factors** *of that number; e.g.*

2, 3, and 5 are factors of 30 because $2 \times 3 \times 5 = 30$.

5. What are the factors of 6? Of 4? Of 10?
6. $6 \div 2 = ?$ $10 \div 2 = ?$ $30 \div 10 = ?$

A number that exactly contains another number is a multiple of that number; e.g.

21 is a multiple of 7. It is also a multiple of 3. A product is always a multiple of its factors.

7. Tell which of the following numbers are multiples, and which are factors:

$4 \times 2 = 8$	$4 \times 3 = 12$	$18 = 6 \times 3$
$3 \times 2 = 6$	$5 \times 3 = 15$	$20 = 5 \times 4$
$3 \times 3 = 9$	$4 \times 4 = 16$	$20 = 5 \times 2 \times 2$
$2 \times 2 \times 2 = 8$	$2 \times 9 = 18$	$24 = 3 \times 8$

8. Every number is a multiple of itself. What is the smallest number that is a multiple of 2?
9. What is the smallest multiple of 2 and 3? Of 3 and 4? Of 2, 3, and 4?
10. Name all of the numbers that are exactly contained in 4; in 6; in 8; in 10; in 9.

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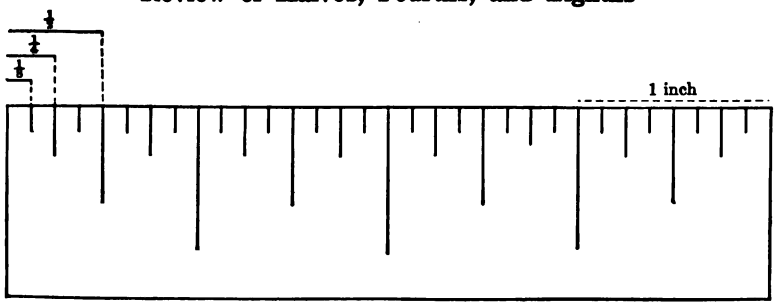
Review of Halves, Fourths, and Eighths



1. How many inch spaces are there on this rule?
2. How many half-inches make an inch?
3. How many quarter-inches make one half-inch?
4. How many eighth-inches make one quarter-inch? One half-inch?

5. $\frac{1}{2} + \frac{1}{4} = ?$ $\frac{1}{2} - \frac{1}{4} = ?$ $\frac{1}{4} + \frac{3}{4} = ?$
6. $\frac{3}{8} + \frac{1}{8} = ?$ $\frac{1}{8} + \frac{1}{4} = ?$ $\frac{3}{8} + \frac{1}{4} = ?$
7. $\frac{7}{8} - \frac{1}{4} = ?$ $\frac{3}{4} - \frac{1}{8} = ?$ $\frac{7}{8} - \frac{1}{2} = ?$

Written

a. Add $\frac{7}{8}$ and $\frac{1}{4}$.

$$\begin{aligned} \tfrac{7}{8} &= \tfrac{7}{8} \\ \tfrac{1}{4} &= \tfrac{2}{8} \\ \tfrac{9}{8} &= 1\tfrac{1}{8} \text{ } \textit{Sum} \end{aligned}$$

b. Add $23\frac{5}{8}$ and $18\frac{3}{4}$.

$$\begin{aligned} 23\tfrac{5}{8} &= 23\tfrac{5}{8} \quad (\tfrac{11}{8} = 1\tfrac{3}{8}) \\ 18\tfrac{3}{4} &= 18\tfrac{6}{8} \\ 41\tfrac{11}{8} &= 42\tfrac{3}{8} \text{ } \textit{Sum} \end{aligned}$$

c. From $75\frac{1}{2}$ take $37\frac{3}{8}$.

$$\begin{aligned} 75\tfrac{1}{2} &= 75\tfrac{4}{8} \\ 37\tfrac{3}{8} &= 37\tfrac{3}{8} \\ 38\tfrac{1}{8} &\text{ } \textit{Remainder} \end{aligned}$$

1. $12\frac{1}{2} + 7\frac{3}{4} = ?$
2. $18\frac{1}{8} + 22\frac{3}{4} = ?$
3. $17\frac{1}{2} + 29\frac{3}{8} = ?$
4. $29\frac{5}{8} - 16\frac{1}{4} = ?$
5. $19\frac{1}{2} + 27\frac{1}{4} = ?$
6. $32\frac{7}{8} + 49\frac{1}{8} = ?$
7. $35\frac{5}{8} + 72\frac{3}{4} = ?$
8. $48\frac{5}{8} - 31\frac{1}{2} = ?$
9. $87\frac{1}{2} - 37\frac{3}{8} = ?$

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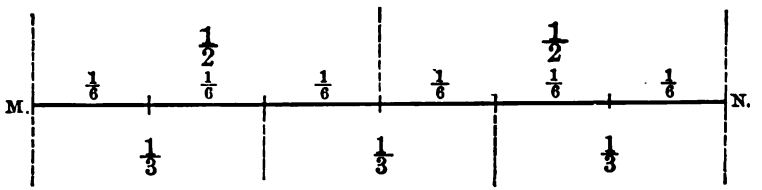

Oral

1. Look at the line *MN* and tell

a. How many sixths there are in $\frac{1}{2}$.

b. How many sixths there are in $\frac{1}{3}$.

c. To what we may change halves and thirds before we add them.

2. $\frac{1}{2} = \frac{?}{6}$; $\frac{1}{3} = \frac{?}{6}$; $\frac{2}{3} = \frac{?}{6}$; $\frac{1}{2} + \frac{1}{3} = \frac{?}{6}$.

3. $\frac{1}{2} - \frac{1}{3} = \frac{?}{6}$; $\frac{2}{3} - \frac{1}{2} = ?$ $\frac{1}{2} - \frac{1}{6} = ?$ $\frac{1}{3} - \frac{1}{6} = ?$

4. $2\frac{1}{2} + 3\frac{1}{3} = ?$ $3\frac{1}{2} + 5\frac{1}{6} = ?$ $7\frac{1}{3} + 2\frac{1}{6} = ?$

5. $5\frac{1}{2} - 3\frac{1}{3} = ?$ $7\frac{1}{2} - 2\frac{1}{6} = ?$ $8\frac{2}{3} - 3\frac{1}{2} = ?$

Written

1. $87\frac{2}{3} - 62\frac{1}{6} = ?$ 2. $59\frac{1}{2} - 38\frac{1}{6} = ?$ 3. $99\frac{5}{6} - 83\frac{1}{2} = ?$

4. $43\frac{5}{6} + 21\frac{1}{3} = ?$ 5. $28\frac{1}{2} + 15\frac{2}{3} = ?$ 6. $15\frac{1}{2} + 37\frac{2}{3} = ?$

7. Esther has three dolls. In making clothes for them she used $\frac{1}{2}$ yd. of muslin, $\frac{1}{3}$ yd. of gingham, and $\frac{1}{6}$ yd. of cotton poplin. How much material did she use in all?

8. Vincent bought $2\frac{2}{3}$ boxes of screws and gave Wilfred $1\frac{1}{6}$ boxes for his shop. How many boxes of screws did Vincent keep?

9. Elton works for Mr. Stone by the hour while out of school. In one week he worked as follows: Monday $1\frac{1}{2}$ hr., Tuesday $2\frac{1}{6}$ hr., Wednesday 2 hr., Thursday $\frac{2}{3}$ hr., Friday $1\frac{1}{3}$ hr., Saturday 6 hr. How many hours did he work during the week?

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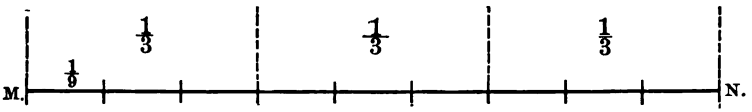

Oral

1. $\frac{1}{3}$ = how many ninths?

2. Find $\frac{2}{9}$ more than $\frac{1}{3}$. Can you express it in thirds? How can you express it?

3. Express $\frac{1}{9}$ more than $\frac{2}{3}$. *In order to add thirds and ninths, we change the thirds to what?*

4. $9 \div 3 = ?$ 9 is what of 3?

5. $\frac{1}{3} + \frac{1}{9} =$ ——
6. $\frac{2}{3} + \frac{4}{9} =$ ——
7. $\frac{2}{3} + \frac{2}{9} =$ ——
8. $\frac{1}{3} + \frac{2}{9} =$ ——
9. $\frac{2}{3} + \frac{1}{9} =$ ——
10. $\frac{1}{3} + \frac{5}{9} =$ ——
11. $\frac{2}{3} + \frac{7}{9} =$ ——
12. $\frac{1}{3} + \frac{8}{9} =$ ——
13. $\frac{1}{3} + \frac{4}{9} =$ ——
14. $\frac{8}{9} + \frac{2}{3} =$ ——
15. $\frac{7}{9} + \frac{1}{3} =$ ——
16. $\frac{5}{9} - \frac{1}{3} =$ ——
17. $\frac{8}{9} - \frac{2}{3} =$ ——
18. $\frac{5}{9} + \frac{2}{3} =$ ——
19. $\frac{7}{9} + \frac{1}{3} =$ ——

Subtract:

20. $\frac{7}{9} - \frac{2}{3}$
21. $\frac{1}{3} - \frac{1}{9}$
22. $\frac{2}{3} - \frac{4}{9}$
23. $\frac{1}{3} - \frac{2}{9}$
24. $\frac{8}{9} - \frac{1}{3}$
25. $\frac{2}{3} - \frac{2}{9}$
26. $\frac{2}{3} - \frac{5}{9}$

Written

1. $18\frac{1}{3} + 171\frac{1}{9}$
2. $56\frac{2}{3} + 14\frac{1}{9}$
3. $75\frac{2}{9} + 43\frac{2}{3}$
4. $38\frac{2}{9} + 41\frac{1}{3}$
5. $341\frac{5}{9} + 23\frac{1}{3}$
6. $86\frac{4}{9} + 61\frac{1}{3}$
7. $19\frac{7}{9} + 32\frac{1}{3}$
8. $75\frac{2}{3} + 46\frac{8}{9}$
9. $73\frac{4}{9} + 18\frac{2}{3}$
10. $111\frac{1}{3} + 211\frac{8}{9}$
11. $421\frac{5}{9} + 16\frac{2}{3}$
12. $39\frac{2}{3} + 16\frac{7}{9}$
13. $83\frac{8}{9} - 43\frac{1}{3}$
14. $24\frac{1}{3} - 14\frac{1}{9}$
15. $47\frac{2}{3} - 19\frac{5}{9}$
16. $97\frac{4}{9} - 18\frac{1}{3}$
17. $125\frac{2}{3} - 42\frac{1}{9}$
18. $120\frac{7}{9} - 16\frac{2}{3}$
19. $216\frac{3}{4} - 19\frac{1}{2}$
20. $42\frac{5}{8} - 13\frac{1}{2}$
21. $34\frac{5}{6} - 13\frac{1}{3}$

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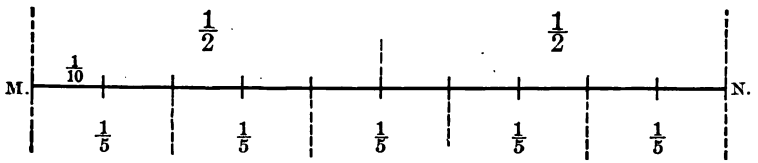

Oral

1. How many tenths are there in $\frac{1}{2}$?

2. How many tenths in $\frac{1}{5}$? In $\frac{2}{5}$? In $\frac{3}{5}$? In $\frac{4}{5}$?

3. $\frac{1}{2} = \frac{?}{10}$; $\frac{1}{5} = \frac{?}{10}$; $\frac{2}{5} = \frac{?}{10}$; $\frac{3}{5} = \frac{?}{10}$; $\frac{4}{5} = \frac{?}{10}$.

4. *In order to add fifths and halves, what must we do first?* $10 \div 2 = ?$ $10 \div 5 = ?$ 10 is what of 5 and 2?

5. $\frac{1}{5}+\frac{1}{2}=$—— 6. $\frac{1}{2}+\frac{2}{5}=$—— 7. $\frac{1}{2}+\frac{3}{5}=$——

8. $\frac{1}{2}+\frac{4}{5}=$—— 9. $\frac{1}{2}-\frac{1}{5}=$—— 10. $\frac{4}{5}-\frac{1}{2}=$——

11. $\frac{1}{2}-\frac{2}{5}=$—— 12. $\frac{3}{5}-\frac{1}{2}=$—— 13. $\frac{4}{5}+\frac{1}{2}=$——

14. $\frac{1}{2}+\frac{5}{5}=$—— 15. $3\frac{1}{2} + 5\frac{2}{5} =$ ——

16. $4\frac{1}{5} + 6\frac{1}{2} =$ —— 17. $8\frac{1}{2} + \frac{4}{5} =$ ——

18. $9\frac{3}{5} - 7\frac{1}{2} =$ —— 19. $11\frac{4}{5} - 3\frac{1}{2} =$ ——

20. Frank shoveled $\frac{1}{2}$ of the sidewalk and Henry $\frac{2}{5}$ of it. What part of the walk was shoveled? What part of the walk was not shoveled?

Written

1.	2.	3.	4.
$235\frac{4}{5}$	$307\frac{1}{2}$	$799\frac{1}{2}$	$293\frac{2}{5}$
$-\ 187\frac{1}{2}$	$-\ 299\frac{1}{5}$	$+\ 609\frac{1}{5}$	$+\ 617\frac{1}{2}$
5.	**6.**	**7.**	**8.**
$9001\frac{4}{5}$	$83\frac{3}{5}$	$428\frac{1}{2}$	$598\frac{4}{5}$
$-\ 8992\frac{1}{2}$	$+\ 79\frac{1}{2}$	$-\ 399\frac{2}{5}$	$+\ 2\frac{1}{2}$

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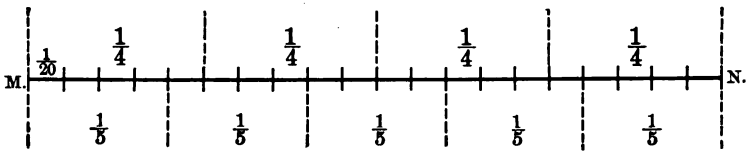

Oral

1. How many are there of the smallest parts of the line *MN?* Each of them is what fraction of the line?

2. $\frac{1}{5}$ = how many twentieths? $\frac{1}{4}$ = how many twentieths? *To what must we change fourths and fifths in order that we may add or subtract them?*

3. $4 \times 5 = ?$ $20 \div 5 = ?$ $20 \div 4 = ?$ 20 is what of 4 and 5? $\frac{2}{5} = \frac{?}{20}$; $\frac{3}{5} = \frac{?}{20}$; $\frac{4}{5} = \frac{?}{20}$; $\frac{2}{4} = \frac{?}{20}$; $\frac{3}{4} = \frac{?}{20}$.

4. $\frac{1}{4}+\frac{1}{20}=?$ 5. $\frac{1}{5}+\frac{1}{20}=?$ 6. $\frac{3}{4}+\frac{1}{20}=?$ 7. $\frac{4}{5}+\frac{1}{20}=?$

8. $\frac{1}{4}+\frac{1}{5}=?$ 9. $\frac{2}{5}+\frac{1}{4}=?$ 10. $\frac{1}{4}+\frac{3}{5}=?$ 11. $\frac{4}{5}+\frac{1}{4}=?$

12. $\frac{3}{4}+\frac{1}{5}=?$ 13. $\frac{2}{5}+\frac{3}{4}=?$ 14. $\frac{3}{5}+\frac{3}{4}=?$ 15. $\frac{3}{4}+\frac{4}{5}=?$

Written

1. $39\frac{1}{4} + 46\frac{7}{20}$

2. $49\frac{3}{4} + 81\frac{3}{20}$

3. $87\frac{11}{20} + 46\frac{1}{5}$

4. $92\frac{1}{5} + 71\frac{1}{4}$

5. $42\frac{3}{4} + 89\frac{1}{5}$

6. $211\frac{9}{20} - 16\frac{3}{4}$

7. $149\frac{4}{5} + \frac{3}{4}$

8. $21\frac{3}{4} - 14\frac{3}{5}$

9. $71\frac{3}{5} - 26\frac{1}{4}$

10. $342\frac{4}{5} - 187\frac{3}{4}$

11. $61\frac{3}{5} + 88\frac{3}{4}$

12. $123\frac{4}{5} - 38\frac{3}{4}$

13. $91\frac{7}{20} + 88\frac{3}{4}$

14. $109\frac{7}{8} - 49\frac{1}{2}$

15. $482\frac{2}{3} - 157\frac{1}{6}$

16. $821\frac{7}{10} - 137\frac{1}{2}$

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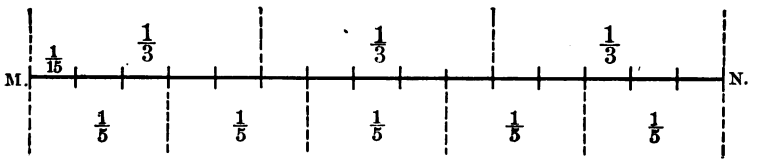

Oral

1. The line *MN* is divided into how many equal parts? What is each of these parts?

2. $\frac{1}{5}$ = how many fifteenths? $\frac{1}{3}$ = how many fifteenths?

3. $\frac{2}{5} = \frac{?}{15}$; $\frac{3}{5} = \frac{?}{15}$; $\frac{4}{5} = \frac{?}{15}$; $\frac{2}{3} = \frac{?}{15}$.

4. $3 \times 5 = ?$ $15 \div 3 = ?$ $15 \div 5 = ?$ 15 is what of 3 and 5?

5. *To what shall we change thirds and fifths so that we may add or subtract them?*

6. $\frac{1}{3} + \frac{1}{15} =$ ——
7. $\frac{1}{5} + \frac{1}{15} =$ ——
8. $\frac{1}{3} + \frac{1}{5} =$ ——
9. $\frac{1}{3} + \frac{2}{5} =$ ——
10. $\frac{1}{5} + \frac{2}{3} =$ ——
11. $\frac{3}{5} + \frac{1}{3} =$ ——
12. $\frac{1}{3} + \frac{4}{5} =$ ——
13. $\frac{2}{5} + \frac{2}{3} =$ ——
14. $\frac{3}{5} + \frac{2}{3} =$ ——
15. $\frac{1}{5} - \frac{1}{15} =$ ——
16. $\frac{1}{3} - \frac{2}{15} =$ ——
17. $\frac{1}{3} - \frac{1}{5} =$ ——

Written

1. $31\frac{1}{3} - 25\frac{1}{5}$
2. $49\frac{1}{3} + 82\frac{1}{5}$
3. $613\frac{2}{5} - 127\frac{1}{3}$
4. $412\frac{2}{3} - 361\frac{2}{5}$
5. $912\frac{2}{3} + 87\frac{7}{15}$
6. $17\frac{1}{3} + 21\frac{2}{5}$
7. $84\frac{3}{5} + 84\frac{1}{3}$
8. $490\frac{2}{3} - 390\frac{10}{15}$

9. Mr. Ruggles worked $4\frac{3}{5}$ months in Boston and $6\frac{2}{3}$ months in Troy. How many months did he work?

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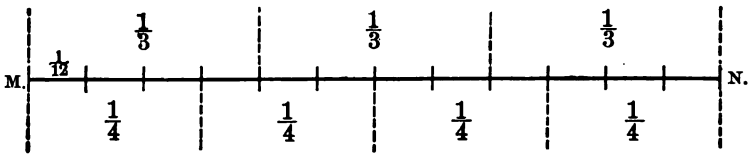

Oral

1. $\frac{1}{3}$ of the line *MN* is how many twelfths of it?
2. $\frac{1}{4}$ of the line *MN* is how many twelfths of it?
3. Can you find how many twelfths in $\frac{1}{2}$ of the line? In $\frac{1}{6}$ of the line?
4. $\frac{2}{3} = \frac{?}{12}$; $\frac{3}{4} = \frac{?}{12}$; $\frac{5}{6} = \frac{?}{12}$; $\frac{1}{2} = \frac{?}{12}$; $\frac{1}{6} = \frac{?}{12}$.
5. *To what shall we change fourths and thirds in order that we may add or subtract them?*
6. $12 \div 4 = ?$ $12 \div 3 = ?$ 12 is what of 4 and 3?
7. $12 \div 2 = ?$ $12 \div 6 = ?$ 12 is what of 6 and 2?
8. Of what four numbers is 12 a multiple?

9. $\frac{2}{3} = \frac{?}{12}$	10. $\frac{3}{4} = \frac{?}{12}$	11. $\frac{1}{4} + \frac{1}{12} = ?$
12. $\frac{3}{4} + \frac{1}{12} = ?$	13. $\frac{1}{3} + \frac{1}{4} = ?$	14. $\frac{2}{3} + \frac{1}{4} = ?$
15. $\frac{3}{4} + \frac{1}{3} = ?$	16. $\frac{2}{3} + \frac{3}{4} = ?$	17. $\frac{1}{6} + \frac{1}{12} = ?$
18. $\frac{1}{2} + \frac{1}{12} = ?$	19. $\frac{1}{12} + \frac{5}{6} = ?$	20. $\frac{5}{12} + \frac{1}{2} = ?$
21. $\frac{1}{4} - \frac{1}{12} = ?$	22. $\frac{1}{3} - \frac{1}{12} = ?$	23. $\frac{1}{3} - \frac{1}{4} = ?$
24. $\frac{2}{3} - \frac{1}{4} = ?$	25. $\frac{3}{4} - \frac{1}{3} = ?$	26. $\frac{3}{4} - \frac{2}{3} = ?$
27. $\frac{3}{4} - \frac{7}{12} = ?$	28. $\frac{2}{3} - \frac{5}{12} = ?$	

Written

1. $16\frac{1}{4}$	2. $25\frac{1}{2}$	3. $43\frac{1}{3}$	4. $84\frac{2}{3}$	5. $415\frac{7}{12}$
$+ 14\frac{11}{12}$	$+ 17\frac{1}{12}$	$- 16\frac{1}{12}$	$+ 18\frac{3}{4}$	$- 247\frac{1}{2}$
6. $14\frac{2}{3}$	7. $67\frac{3}{4}$	8. $395\frac{3}{4}$	9. $59\frac{11}{12}$	10. $135\frac{7}{12}$
$+ 93\frac{1}{4}$	$+ 88\frac{1}{3}$	$- 197\frac{2}{3}$	$- 41\frac{3}{4}$	$+ 296\frac{3}{4}$

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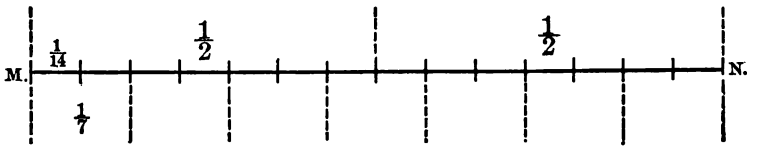

Oral

1. Into how many equal parts is the line MN divided? What is each of these parts called?

2. $\frac{1}{7} = \frac{?}{14}$; $\frac{1}{2} = \frac{?}{14}$; $\frac{2}{7} = \frac{?}{14}$; $\frac{3}{7} = \frac{?}{14}$; $\frac{4}{7} = \frac{?}{14}$; $\frac{5}{7} = \frac{?}{14}$ $\frac{6}{7} = \frac{?}{14}$.

3. *To what shall we change halves and sevenths in order that we may add or subtract them?*

4. $14 \div 2 = ?$ $14 \div 7 = ?$ 14 is what of 2 and 7?

5. $\frac{1}{2} - \frac{1}{7} = ?$ $\frac{1}{2} - \frac{2}{7} = ?$ $\frac{1}{2} - \frac{3}{7} = ?$

6. $\frac{1}{2} + \frac{1}{7} = ?$ $\frac{1}{2} + \frac{2}{7} = ?$ $\frac{1}{2} + \frac{4}{7} = ?$

7. $\frac{1}{2} + \frac{5}{7} = ?$ $\frac{1}{2} + \frac{6}{7} = ?$ $\frac{1}{2} + \frac{1}{14} = ?$ $\frac{1}{2} + \frac{2}{14} = ?$ $\frac{1}{7} + \frac{5}{14} = ?$

8. $\frac{1}{2} + \frac{1}{7} + \frac{1}{14} = ?$ $\frac{1}{2} + \frac{2}{7} + \frac{1}{14} = ?$ $\frac{1}{2} + \frac{3}{7} + \frac{3}{14} = ?$

Written

1. *Add:*

a.	*b.*	*c.*	*d.*	*e.*
$13\frac{1}{2}$	$140\frac{1}{2}$	$23\frac{5}{14}$	$131\frac{3}{14}$	$981\frac{6}{7}$
$15\frac{1}{7}$	$139\frac{5}{7}$	$259\frac{3}{7}$	$87\frac{1}{2}$	$49\frac{1}{2}$
$28\frac{1}{14}$	64	$164\frac{1}{2}$	$63\frac{4}{7}$	$88\frac{9}{14}$

2. *Subtract:*

a.	*b.*	*c.*	*d.*	*e.*
$401\frac{1}{2}$	$71\frac{1}{2}$	$73\frac{1}{2}$	$391\frac{4}{7}$	$81\frac{5}{7}$
$359\frac{1}{7}$	$36\frac{2}{7}$	$15\frac{3}{7}$	$158\frac{1}{2}$	$29\frac{1}{2}$

3. *Add:*

a.	*b.*	*c.*	*d.*	*e.*
$13\frac{1}{2}$	$76\frac{5}{8}$	$43\frac{1}{2}$	$120\frac{11}{20}$	$12\frac{3}{7}$
$15\frac{3}{8}$	$19\frac{3}{8}$	$15\frac{2}{3}$	$96\frac{1}{5}$	$15\frac{11}{14}$
$4\frac{3}{4}$	$5\frac{3}{4}$	$7\frac{1}{6}$	$14\frac{1}{4}$	$14\frac{1}{2}$

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1. Name a number which is a multiple of 8 and 3.

2. If we wish to add or subtract eighths and thirds, to what shall we change them?

3. Name all the numbers of which 24 is a multiple. What fractions other than eighths and thirds can you add or subtract by changing them to 24ths?

4. $\frac{1}{8} = \frac{?}{24}$; $\frac{1}{3} = \frac{?}{24}$; $\frac{1}{4} = \frac{?}{24}$; $\frac{1}{6} = \frac{?}{24}$; $\frac{1}{12} = \frac{?}{24}$.

5. $\frac{1}{2} = \frac{?}{24}$; $\frac{3}{8} = \frac{?}{24}$; $\frac{2}{3} = \frac{?}{24}$; $\frac{3}{4} = \frac{?}{24}$; $\frac{5}{6} = \frac{?}{24}$; $\frac{5}{12} = \frac{?}{24}$.

6. $\frac{5}{8} = \frac{?}{24}$; $\frac{7}{12} = \frac{?}{24}$; $1\frac{1}{12} = \frac{?}{24}$; $\frac{1}{3} + \frac{1}{8} = ?$ $\frac{1}{8} - \frac{1}{12} = ?$

7. $\frac{1}{8} + \frac{1}{6} = ?$ $\frac{1}{6} - \frac{1}{8} = ?$ $\frac{1}{3} + \frac{5}{24} = ?$ $\frac{1}{2} - \frac{1}{24} = ?$ $\frac{1}{8} + \frac{7}{24} = ?$

Written

1. $35\frac{1}{3}$	2. $81\frac{1}{3}$	3. $24\frac{1}{4}$	4. $52\frac{1}{8}$	5. $29\frac{3}{8}$
$+ 42\frac{1}{8}$	$- 37\frac{1}{8}$	$+ 99\frac{1}{6}$	$+ 49\frac{5}{6}$	$- 16\frac{1}{12}$
6. $48\frac{7}{12}$	7. $405\frac{1}{12}$	8. $48\frac{7}{8}$	9. $479\frac{7}{8}$	10. $405\frac{5}{6}$
$- 29\frac{3}{8}$	$- 98\frac{5}{8}$	$+ 91\frac{2}{3}$	$- 379\frac{2}{3}$	$- 399\frac{5}{8}$
11. $43\frac{7}{12}$	12. $72\frac{2}{3}$	13. $35\frac{5}{8}$	14. $213\frac{7}{8}$	15. $315\frac{5}{6}$
$+ 89\frac{5}{24}$	$- 16\frac{5}{8}$	$+ 88\frac{2}{3}$	$- 164\frac{2}{3}$	$- 143\frac{1}{4}$
16. $43\frac{5}{24}$	17. $16\frac{1}{24}$	18. $99\frac{3}{8}$	19. $71\frac{5}{8}$	20. $63\frac{5}{16}$
$64\frac{4}{24}$	$19\frac{7}{24}$	$63\frac{5}{24}$	$99\frac{3}{8}$	$47\frac{7}{16}$
$13\frac{7}{24}$	$22\frac{9}{24}$	$71\frac{1}{4}$	$16\frac{2}{3}$	$31\frac{1}{16}$
$18\frac{1}{24}$	$31\frac{5}{24}$	$81\frac{1}{12}$	$14\frac{1}{6}$	$2\frac{1}{6}$

21. $3\frac{1}{2} + 4\frac{2}{3} + 5\frac{1}{4} = ?$ 22. $6\frac{2}{5} + 3\frac{3}{10} + 14\frac{3}{20} = ?$

23. $3\frac{1}{2} + 3\frac{5}{6} + 6\frac{5}{24} = ?$

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Oral

1. To what would you change ninths and halves if you wished to add or subtract them?

2. What other fractions than ninths and halves could be added or subtracted by making the same change?

3. What is the smallest number that exactly contains 2, 3, 6, and 9?

4. $\frac{1}{2}=\frac{?}{18}$; $\frac{1}{3}=\frac{?}{18}$; $\frac{1}{6}=\frac{?}{18}$; $\frac{1}{9}=\frac{?}{18}$; $\frac{2}{3}=\frac{?}{18}$; $\frac{2}{9}=\frac{?}{18}$; $\frac{5}{6}=\frac{?}{18}$.

5. $\frac{4}{9}=\frac{?}{18}$; $\frac{5}{9}=\frac{?}{18}$; $\frac{7}{9}=\frac{?}{18}$; $\frac{8}{9}=\frac{?}{18}$.

6. $\frac{1}{3}+\frac{1}{18}=?$ $\frac{1}{2}+\frac{5}{18}=?$ $\frac{1}{6}+\frac{11}{18}=?$ $\frac{1}{9}+\frac{15}{18}=?$

7. $\frac{1}{2}+\frac{1}{9}=?$ $\frac{1}{2}-\frac{1}{9}=?$ $\frac{1}{2}+\frac{4}{9}=?$ $\frac{1}{6}+\frac{2}{9}=?$ $\frac{1}{9}+\frac{5}{6}=?$

8. $\frac{5}{9}-\frac{1}{2}=?$ $\frac{7}{9}+\frac{1}{2}=?$ $\frac{8}{9}-\frac{1}{2}=?$ $\frac{3}{9}+\frac{5}{6}=?$

Written

1.	2.	3.	4.	5.
$39\frac{1}{3}$	$316\frac{5}{9}$	$45\frac{1}{2}$	$38\frac{4}{8}$	$486\frac{5}{18}$
$+\ 42\frac{7}{18}$	$-\ 215\frac{1}{2}$	$-\ 27\frac{2}{9}$	$+\ 98\frac{1}{2}$	$+\ 397\frac{1}{2}$

6.	7.	8.	9.	10.
$32\frac{11}{18}$	$99\frac{1}{6}$	$304\frac{7}{9}$	$392\frac{2}{3}$	$83\frac{1}{2}$
$-\ 23\frac{4}{9}$	$+\ 99\frac{1}{9}$	$-\ 108\frac{1}{2}$	$-\ 186\frac{7}{18}$	$-\ 47\frac{2}{9}$

11.	12.	13.	14.	15.
$203\frac{5}{9}$	$84\frac{5}{6}$	$45\frac{1}{2}$	$79\frac{2}{3}$	$239\frac{1}{2}$
$-\ 107\frac{1}{6}$	$+\ 17\frac{1}{9}$	$-\ 13\frac{1}{4}$	$-\ 16\frac{2}{9}$	$-\ 175\frac{3}{8}$

16.	17.	18.	19.	20.
$43\frac{7}{18}$	$39\frac{1}{9}$	$99\frac{1}{9}$	$43\frac{1}{9}$	$8\frac{7}{18}$
$56\frac{11}{18}$	$25\frac{1}{6}$	$25\frac{1}{6}$	$51\frac{1}{9}$	$2\frac{1}{3}$
$23\frac{5}{18}$	$41\frac{1}{2}$	$42\frac{1}{3}$	$17\frac{1}{2}$	$6\frac{5}{9}$

21. $11\frac{2}{9}+6\frac{1}{3}+7\frac{1}{6}+3\frac{5}{18}=?$

22. $4\frac{5}{6}+1\frac{1}{9}+2\frac{1}{18}+3\frac{1}{3}=?$

23. $5\frac{1}{9}+2\frac{1}{6}+8\frac{1}{2}+4\frac{1}{3}=?$

24. $3\frac{1}{6}+4\frac{1}{8}+5\frac{1}{3}+2\frac{1}{4}=?$

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REVIEW AND PRACTICE

Oral

1. What is the cost of 50 five-cent stamps?
2. Five 50-cent tennis balls cost how much?
3. 11 and 11 are the factors of what number?
4. Of what number are 3, 7, and 5 the factors?
5. What is the smallest multiple of 3, 8, and 6?
6. What is the cost of 9 junior baseballs at 70¢ each?
7. 70 writing pads at 9¢ apiece cost how much?
8. How many days will a 12-gallon keg of water last 24 shipwrecked men if each man drinks a pint a day?
9. If Frances can knit 21 stitches a minute, how many stitches can she knit in half an hour?
10. The product of 20 and 16 is how much less than 20 times 20?
11. A silver dollar was given in payment for a chicken costing 78 cents and a pound of sausage at 19¢. What was the change?
12. Our schoolroom has a double floor. The upper part is $\frac{7}{8}$ of an inch thick and the part underneath is $\frac{3}{4}$ of an inch thick. How thick is the entire floor?
13. Find the sums by adding the tens first:

    $56 + 24$; $37 + 22$; $59 + 26$; $43 + 19$.

14. Find the differences by subtracting the tens first:

    $81 - 32$; $93 - 46$; $85 - 28$; $125 - 56$.

15. How many cars will be needed to carry our school of 400 pupils to a picnic if each car carries 50?
16. A man receiving $21 a week was advanced to $33 a week. What was the advance per day?
17. Andrew took a $5 bill with which to pay the month's gas bill of $1.80. How much change should he bring back?
18. Let each pupil give a fraction problem to the next.

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Written

1. What must be added to \$38.79 to make \$341.81?

2. One factor of 14,319 is 37. What is the other?

3. The two factors of a number are 829 and 736. Find the number.

4. Add $17\frac{1}{2}$, $29\frac{1}{8}$, $16\frac{3}{4}$, and $\frac{7}{8}$.

5. My speedometer registered $1098\frac{3}{10}$ miles when I started for a drive, and $1124\frac{8}{10}$ miles when I returned. How many miles did I drive?

6. Six girls share equally the cost of a picnic lunch. If the sandwiches cost 55¢, the fruit 40¢, the eggs 43¢, the cheese 16¢, the pickles 12¢, and the lemonade 20¢, what will be each girl's share of the cost?

7. A playground is 30 yd. square. How many feet does John travel in running around it four times? (Make a drawing.)

8. A man built a house, paying \$397.65 for lumber, \$125.50 for stone work, \$57.60 for brick work, \$147.25 for plastering, \$66.85 for painting, \$150.40 for labor, \$31.75 for grading, and \$41 for other expenses. What was the cost of the house?

9. Find the cost of the street lamps in one city block, if there are three lamps on each side and each lamp costs \$75.

10. An automobile factory makes 327 automobiles a day. In how many days can it make 318,825 automobiles?

11. What profit does George make in four weeks if he sells 30 *Posts* a week at 5¢ a copy and 10 *Journals* at 15¢ a copy, when the *Post* costs 3¢ a copy and the *Journal* 11¢?

12. It takes one gallon of gasoline to run my automobile 20 miles. If the gasoline costs 23¢ a gallon, how much would it cost to run a distance of 120 miles? (120 is how many times 20?)

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13. What is the value of 1021 acres of wheat land at $99 an acre?

14. What will it cost to travel 107 miles and return if the fare is $2\frac{1}{2}¢$ a mile?

15. How many years will it take a man to save $3528 if he saves $392 each year? (Notice that $3528 is almost $3600, and $392 is almost $400.)

16. A motor truck is built to carry 3000 pounds. How many barrels of salt, each weighing 280 pounds, could it carry safely?

17. An elevator car can carry safely 1300 pounds. The operator has admitted people weighing 112 lb., 152 lb., 148 lb., 205 lb., 195 lb., 103 lb., 175 lb., and 124 lb. Should he admit another weighing 200 lb.?

18. The admission fee to our school entertainment is 25 cents. How much shall we receive from 413 admissions?

19. If steel rails weigh 90 pounds for every foot of their length, how many feet of rails will a ton of steel make?

20. Wages at 45¢ an hour, 8 hours a day, 300 days in a year, amount to how much in a year?

21. $235 + 160 + 405 + 816 + 783 = ?$

22. $26 \times 989 = ?$

23. $365{,}000 \div 350 = ?$

24. $\frac{2}{5}$ of 51,302 = ?

25. $\$\frac{3}{4} \times 8120 = ?$

Subtract:

26. 38264 29842	27. 19327 8291	28. 92593 87246	29. 27075 18092
30. $2.15 1.12	31. $35.28 17.05	32. $25.18 1.15	33. $36.51 16.82
34. $34.28 24.28	35. $39.21 27.13	36. $17.80 16.75	37. $75.00 24.32

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ESTIMATING ANSWERS

It is often desirable to estimate pretty closely what the answer to a problem should be, without working it through. For example, Mr. Brant has 325 bushels of potatoes to sell, and he needs to know at once about what they are worth at 98 cents a bushel. He says, "98 cents is almost one dollar. So the potatoes are worth almost a dollar a bushel; 325 bushels are worth almost $325." If you were asked to find the exact value of 325 bushels of potatoes at 98¢ a bushel and should get $28 or $7340 for an answer, you would know, by estimating, that neither of these is the correct answer. *Remember that estimating is not merely guessing.* It is finding pretty nearly the correct result by using your reason, or "common sense," as it is sometimes called. It is well, always, to "check" your results by estimating, to determine whether or not the answer seems reasonable. If it is not reasonable, you had better look for a mistake.

Estimate the answers to the following questions, and then verify your estimates by actually performing the operations:

1. $796 + 803 + 489 + 115 = ?$
2. $12{,}231 - 9215 = ?$
3. $1129 \times 9 = ?$
4. $45{,}126 \div 5 = ?$
5. $\frac{2}{3}$ of $3024 = ?$

6. A group of people planted 251 acres of potatoes on their "war farm," and expected a yield of 90 bushels per acre. How many bushels did they expect to have in all?

7. 814 acres of wheat should yield how many bushels. at 21 bushels per acre?

8. What would 1015 typewriters cost at $52 apiece?

9. How many years would it take for a man to save $5125 if he saved $503 a year?

10. How many men can be carried in five transports if each transport carries 1124 men?

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Quick Mental Test

1. $5 + 9 + 6 + 8 + 11 = ?$
2. $28 + ? = 45$
3. $73 \times 100 = ?$
4. $16 \times ? = 64$
5. $\frac{1}{2} + \frac{2}{3} = ?$
6. $7 \times ? = 52$
7. $? + 16 = 31$
8. $\$1.00 - \$.53 = ?$
9. $38 + 43 = ?$
10. $\$.27 + ? = \$1.00$

Short Written Tests

I. *Find sums and test your work.* Can you do it in five minutes? Do not copy addends.

1.	2.	3.	4.
49	235	8749	$346.25
392	419	3254	29.48
48	786	286	934.29
6759	592	39	98.65
24	839	458	813.78
864	496	3476	92.48
9837	318	239	9.62
481	745	8375	46.78
28	932	468	932.86

II. *Subtract and test:*

1.	2.	3.	4.
4352	38290	4001	603,040
1987	8199	102	13,048

III. *Divide and test:*

1. 153,825 by 25. 2. 49,386 by 78. 3. 12,364 by 500.

IV. *Add:*

1.	2.	3.	4.
$245\frac{5}{7}$	$73\frac{2}{3}$	$96\frac{5}{8}$	$88\frac{7}{9}$
$321\frac{3}{7}$	$48\frac{1}{2}$	$79\frac{2}{3}$	$59\frac{1}{2}$

V. *Subtract:*

1.	2.	3.	4.
$342\frac{2}{3}$	$93\frac{3}{5}$	$842\frac{3}{4}$	$937\frac{2}{3}$
$186\frac{1}{12}$	$29\frac{1}{3}$	$468\frac{2}{3}$	$841\frac{2}{7}$

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DIFFERENT KINDS OF NUMBERS

The names of the different forms of numbers, such as integers, fractions, mixed numbers, etc., are defined here, so that you may know what is meant when you see or hear them. Do not take time to commit these definitions to memory and recite them, but merely refer to them when necessary.

A number that has no fractional part is an **integer**; *e.g.* 6, 9, 21, 14.

A number that is composed of an integer and a fraction is a **mixed number**; *e.g.* $3\frac{1}{2}$, $11\frac{1}{3}$.

In speaking of the factors of a number, we usually refer only to factors that are integers; though a fraction or a mixed number may be a factor.

A number that has no factor but itself and 1 is a **prime number**; *e.g.* 1, 2, 3, 5, 7, 11.

A number that has other factors than itself and 1 is a **composite number**; *e.g.* 4, 15, 9, 35.

A factor that is a prime number is a **prime factor**; *e.g.* 5 and 3 are prime factors of 30.

A number that has a factor 2 is an **even number**; *e.g.* 2, 4, 6, 8, 10.

A number that has no factor 2 is an **odd number**; *e.g.* 3, 5, 7, 9.

Oral

1. Classify these numbers by telling whether they are prime or composite: 2, 7, 11, 6, 9, 15, 19, 16, 18, 27.
2. What even number is prime?
3. Which of the odd numbers given in question 1 are composite?
4. Which of the even numbers are composite?
5. Name all the prime numbers smaller than 50.
6. Give the prime factors of 4; of 9; of 12; of 21; of 30.

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FRACTIONS

There is a growing tendency to express fractional quantities *approximately* in decimals, rather than *exactly* in common fractions. Common fractions used in measurements seldom have denominators larger than 24. The informal work with fractions thus far given in these books has made use of none but small fractions. No large denominators will be used in the work which follows.

Nevertheless, we must take account of the fact that the fractional form appears often in the process of computation, and pupils should learn enough of the formal processes with fractions so that they will not be utterly lost when they encounter a fractional expression in larger terms.

A fraction is always an expression of **division.**

For example, if 1 inch is divided into 8 equal parts, each part is $\frac{1}{8}$ of an inch. If a line 7 inches long is divided into 8 equal parts, one part is $\frac{7}{8}$ of an inch long. That is, 1 inch $\div$ 8 = $\frac{1}{8}$ inch, and 7 inches $\div$ 8 = $\frac{7}{8}$ inch.

Take your rule and draw a line 1 inch long. Divide it into 4 equal parts. How long is one part? Draw a line 3 inches long. Divide it into 4 equal parts. Measure one of the parts. 3 inches $\div$ 4 = ?

Draw a line 5 inches long. Divide it into 8 equal parts. Measure one of the parts. 5 inches $\div$ 8 = ? $3 \div 7 = ?$ $9 \div 11 = ?$

Fractions may be read in two ways: e.g.

$\frac{3}{4}$ may be read *three fourths*, or, *three divided by four*; $\frac{16}{3}$ may be read *sixteen thirds*, or, *sixteen divided by three.*

Oral

1. Read each of the following fractions in two ways:

$\frac{2}{3}$, $\frac{5}{8}$, $\frac{17}{2}$, $\frac{16}{4}$, $\frac{9}{2}$, $\frac{13}{14}$, $\frac{25}{5}$, $\frac{7}{16}$, $\frac{9}{15}$.

2. Give the values of the following fractions as integers (thus, $\frac{4}{2} = 4 \div 2 = 2$): $\frac{4}{2}$, $\frac{8}{4}$, $\frac{12}{3}$, $\frac{32}{4}$, $\frac{48}{8}$, $\frac{50}{10}$, $\frac{70}{7}$, $\frac{80}{5}$, $\frac{24}{12}$.

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3. Give the values of the following fractions as mixed numbers (thus, $\frac{5}{2} = 5 \div 2 = 2\frac{1}{2}$):

$\frac{5}{2}$, $\frac{4}{3}$, $\frac{9}{8}$, $\frac{13}{4}$, $\frac{23}{7}$, $\frac{69}{9}$, $\frac{48}{7}$, $\frac{31}{25}$, $\frac{121}{50}$.

4. (For the stronger pupils.) Can you express the following mixed numbers as fractions?

$1\frac{1}{2}$, $1\frac{1}{3}$, $2\frac{1}{3}$, $5\frac{1}{3}$, $6\frac{2}{3}$, $4\frac{5}{8}$, $7\frac{3}{4}$, $9\frac{1}{7}$, $3\frac{7}{9}$.

Common Factors

1. What are the factors of 6? Of 9? Of 15? Of 21?
2. Of which of these numbers is 3 a factor?
3. What are the factors of 10? Of 15? Of 25? Of 35?
4. Of how many of those numbers is 5 a factor?
5. Name two numbers of which 4 is a factor.
6. Name four numbers of which 2 is a factor.

> *A factor that is found in each of two numbers* is a **common factor** of those numbers;
>
> *e.g.* 5 is a common factor of 10 and 15.
> 11 is a common factor of 22 and 77.

7. What is the common factor of 2 and 4? Of 21 and 28? Of 25 and 15?
8. What three common factors have 72 and 12?
9. What common factors have 2 and 3; 4 and 9?

> *Numbers that have no common factor* are **prime to each other**;
>
> *e.g.* 7 and 12 are prime to each other.

10. Which of these groups of numbers are prime to each other: 12 and 8; 7 and 9; 16 and 9; 12 and 10?

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Terms of a Fraction

The number above the line in a fraction is the **numerator.** *It is always a* **dividend.**

In the fractions $\frac{1}{3}$, $\frac{7}{9}$, $\frac{23}{12}$, the numerators are 1, 7, and 23.

The number below the line in a fraction is the **denominator.** *It is always a* **divisor.**

In the fractions $\frac{1}{3}$, $\frac{7}{9}$, $\frac{23}{12}$, the denominators are 3, 9, and 12.

The numerator and denominator are the **terms of a fraction;** *e.g.* The terms of $\frac{7}{11}$ are 7 and 11.

Reduction to Lower or Higher Terms

Notice that when we say 4 pt. = 2 qt., the two numbers have the same *value.* We have changed only the *form.* Just so, when we say 48 oz. = 3 lb.; $\frac{2}{4} = \frac{1}{2}$; $\frac{11}{3} = 3\frac{2}{3}$; $\frac{3}{5} = \frac{12}{20}$.

Changing the form of a number without changing its value is **reduction;**

e.g. 8 pt. = 4 qt.; 7 ft. = $2\frac{1}{3}$ yd.; $\frac{12}{4} = 3$; $\frac{18}{24} = \frac{3}{4}$; $\frac{2}{5} = \frac{6}{15}$.

A fraction is in its **lowest terms** *when the numerator and denominator are prime to each other; e.g.* $\frac{5}{7}$, $\frac{3}{11}$, $\frac{19}{20}$.

Oral

1. Dividing both dividend and divisor by the same number affects the quotient how?

2. $\frac{48}{20}$ compares how with $\frac{12}{5}$?

3. $\frac{6}{21}$ compares how with $\frac{2}{7}$? What did we do with the terms of $\frac{6}{21}$ to obtain $\frac{2}{7}$?

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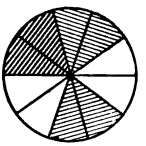
4. Show by these circles that

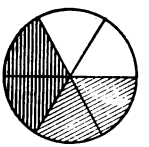
$\frac{2}{6} = \frac{1}{3}$ $\quad \frac{4}{6} = \frac{2}{3}$

$\frac{2}{10} = \frac{1}{5}$ $\quad \frac{4}{10} = \frac{2}{5}$

$\frac{6}{10} = \frac{3}{5}$ $\quad \frac{8}{10} = \frac{4}{5}$

$\frac{5}{10} = \frac{1}{2}$





5. How are these fractions reduced to lowest terms?

6. Reduce to lowest terms: $\frac{2}{4}$; $\frac{3}{6}$; $\frac{6}{8}$; $\frac{3}{9}$; $\frac{2}{6}$; $\frac{5}{10}$; $\frac{4}{8}$; $\frac{6}{9}$; $\frac{9}{12}$; $\frac{2}{8}$; $\frac{2}{10}$; $\frac{7}{14}$; $\frac{3}{12}$; $\frac{5}{15}$; $\frac{6}{12}$; $\frac{9}{18}$; $\frac{4}{12}$; $\frac{2}{14}$; $\frac{14}{18}$; $\frac{15}{20}$; $\frac{16}{24}$; $\frac{12}{15}$.

Since a fraction may be reduced to lower terms by dividing both terms by the same number, it follows that a fraction may be reduced to **higher terms** *by* **multiplying** *both terms by the same number;*

e.g. $\frac{2}{5} = \frac{10}{25} = \frac{40}{100}$, etc.

7. $\frac{5}{7} = \frac{?}{14}$ $\quad$ 8. $\frac{2}{3} = \frac{?}{15}$ $\quad$ 9. $\frac{5}{9} = \frac{?}{27}$

Written

Reduce $\frac{42}{48}$ to lowest terms.

$\frac{42}{48} = \frac{21}{24} = \frac{7}{8}$. *Ans.* We divide both terms by 2 and then by 3.

If we use the largest common factor, we shall need to divide only once, thus $\frac{42}{48} = \frac{7}{8}$.

We may often save time by remembering that an even number will never exactly divide an odd number. Can you tell why?

Reduce to lowest terms:

1. $\frac{36}{54}$	2. $\frac{72}{96}$	3. $\frac{27}{81}$	4. $\frac{45}{95}$	5. $\frac{88}{96}$
6. $\frac{55}{99}$	7. $\frac{36}{72}$	8. $\frac{36}{64}$	9. $\frac{42}{54}$	10. $\frac{15}{60}$
11. $\frac{13}{26}$	12. $\frac{96}{54}$	13. $\frac{48}{60}$	14. $\frac{50}{75}$	15. $\frac{39}{52}$
16. $\frac{15}{75}$	17. $\frac{36}{60}$	18. $\frac{72}{84}$	19. $\frac{31}{93}$	20. $\frac{51}{69}$

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Reduction to Higher Terms

1. Reduce $\frac{5}{8}$ to 40ths.

$$\frac{5 \times 5}{8 \times 5} = \frac{25}{40}. \quad Ans.$$

Since the dividend and divisor are multiplied by the same number, the value of the fraction is unchanged.

2. Reduce $\frac{5}{16}$ to 32ds.

3. Reduce $\frac{7}{25}$ to 75ths.

4. $\frac{13}{20} = \frac{?}{80}$

5. $\frac{19}{41} = \frac{?}{82}$

6. $\frac{14}{31} = \frac{?}{93}$

Reduce:

7. $\frac{5}{9}$ to 36ths.
8. $\frac{7}{8}$ to 32ds.
9. $\frac{7}{9}$ to 36ths.
10. $\frac{8}{15}$ to 45ths.
11. $\frac{1}{10}$ to 90ths.
12. $\frac{5}{16}$ to 64ths.
13. $\frac{15}{20}$ to 40ths.
14. $\frac{9}{16}$ to 32ds.
15. $\frac{3}{10}$ to 50ths.

Reduction of Fractions to Integers or Mixed Numbers

Oral

1. Two half-dollars make how many dollars?
2. Two half-pints make how many pints?
3. Four quarter-dollars make how many dollars?
4. $\frac{3}{3}$ yd. = how many yards?
5. $\frac{10}{10}$ ct. = how many cents?
6. $\frac{9}{9}$ = how many? $\frac{7}{7}$? $\frac{20}{20}$? $\frac{18}{18}$? $\frac{21}{21}$?
7. Any fraction whose terms are alike equals what?

$\frac{12}{3} = 12 \div 3$, or 4 $\qquad \frac{18}{9} = 18 \div 9$, or 2

$\frac{17}{4} = 17 \div 4$, or $4\frac{1}{4}$ $\qquad \frac{47}{7} = 47 \div 7$, or $6\frac{5}{7}$

When the numerator of a fraction is larger than its denominator, the division may be performed and the result will be an integer or a mixed number; e.g.

$\frac{12}{3} = 12 \div 3 = 4$; $\frac{23}{7} = 23 \div 7 = 3\frac{2}{7}$.

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Find the values:

8. $\frac{4}{2}$	12. $\frac{10}{4}$	16. $\frac{25}{6}$	20. $\frac{73}{7}$	24. $\frac{245}{5}$
9. $\frac{5}{4}$	13. $\frac{7}{3}$	17. $\frac{39}{7}$	21. $\frac{80}{11}$	25. $\frac{17}{12}$
10. $\frac{6}{3}$	14. $\frac{13}{3}$	18. $\frac{40}{8}$	22. $\frac{91}{9}$	26. $\frac{46}{11}$
11. $\frac{7}{2}$	15. $\frac{17}{5}$	19. $\frac{51}{3}$	23. $\frac{124}{2}$	27. $\frac{74}{12}$

Written

1. $\frac{191}{4}$	6. $\frac{292}{14}$	11. $\frac{267}{32}$
2. $\frac{376}{25}$	7. $\frac{817}{27}$	12. $\frac{785}{37}$
3. $\frac{343}{18}$	8. $\frac{960}{39}$	13. $\frac{893}{46}$
4. $\frac{467}{14}$	9. $\frac{379}{37}$	14. $\frac{912}{89}$
5. $\frac{879}{37}$	10. $\frac{348}{18}$	15. $\frac{352}{13}$

FINDING THE LEAST COMMON DENOMINATOR

We have found (pages 32 and 33) that when we add or subtract halves and fourths, we change the halves to fourths; that when we add or subtract halves and thirds, we change them both to sixths; and so on. That is, we must change them to fractions whose denominators are alike.

Fractions whose denominators are alike have a **common denominator**; *e.g.*

10 is a common denominator of $\frac{3}{10}$, $\frac{5}{10}$, and $\frac{7}{10}$.

Two or more fractions having the smallest possible common denominator are said to have their **least common denominator**; *e.g.*

$\frac{1}{2}$ and $\frac{2}{3} = \frac{3}{6}$ and $\frac{4}{6}$; 6 is the least common denominator of $\frac{1}{2}$ and $\frac{2}{3}$.

$\frac{1}{2}$ and $\frac{2}{3}$ are equal to $\frac{6}{12}$ and $\frac{8}{12}$, but 12 is not the least common denominator of $\frac{1}{2}$ and $\frac{2}{3}$, because they have a smaller common denominator (6). The least common denominator is always the smallest number that will exactly contain each of the given denominators.

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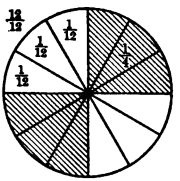
Reduce $\frac{3}{4}$, $\frac{5}{6}$, and $\frac{2}{3}$ to fractions having the least common denominator.

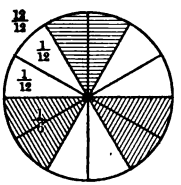
How many 12ths in $\frac{1}{4}$? $(12 \div 4 = 3)$

How many 12ths in $\frac{3}{4}$? $\left(\frac{3 \times 3}{4 \times 3} = \frac{9}{12}\right)$



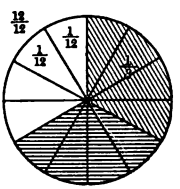
How many 12ths in $\frac{1}{6}$? $(12 \div 6 = 2)$

How many 12ths in $\frac{5}{6}$? $\left(\frac{5 \times 2}{6 \times 2} = \frac{10}{12}\right)$



How many 12ths in $\frac{1}{3}$? $(12 \div 3 = 4)$

How many 12ths in $\frac{2}{3}$? $\left(\frac{2 \times 4}{3 \times 4} = \frac{8}{12}\right)$



This example may be expressed as follows:

L. C. D. = 12

$$\frac{3}{4} = \frac{3 \times 3}{4 \times 3} = \frac{9}{12}$$

$$\frac{5}{6} = \frac{5 \times 2}{6 \times 2} = \frac{10}{12}$$

$$\frac{2}{3} = \frac{2 \times 4}{3 \times 4} = \frac{8}{12}$$

NOTE. — To find the least common denominator:

1. See if the largest given denominator will contain each of the others; if it will, it is the least common denominator.

2. If the largest given denominator will not contain each of the others, multiply it by 2 and see if the product will contain all of them. If it will not, then multiply the same denominator by 3, 4, 5, and so on, until a number is found that will contain each of the given denominators.

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Change the following to fractions having the least common denominator:

1. $\frac{1}{2}, \frac{3}{4}$
2. $\frac{2}{3}, \frac{5}{6}$
3. $\frac{1}{2}, \frac{7}{9}$
4. $\frac{5}{7}, \frac{1}{14}, \frac{1}{2}$
5. $\frac{1}{5}, \frac{1}{3}, \frac{7}{15}$
6. $\frac{1}{2}, \frac{2}{7}, \frac{1}{21}$
7. $\frac{2}{3}, \frac{5}{9}, \frac{7}{18}$
8. $\frac{5}{6}, \frac{3}{4}, \frac{2}{3}$
9. $\frac{6}{5}, \frac{5}{6}, \frac{1}{2}$
10. $\frac{7}{9}, \frac{2}{3}, \frac{3}{2}$
11. $\frac{1}{2}, \frac{3}{4}, \frac{5}{6}, \frac{7}{12}$
12. $\frac{1}{3}, \frac{2}{5}, \frac{2}{3}, \frac{7}{15}$
13. $\frac{5}{24}, \frac{1}{8}, \frac{1}{3}$
14. $\frac{3}{8}, \frac{7}{12}, \frac{5}{6}$
15. $\frac{5}{9}, \frac{1}{2}, \frac{1}{6}$
16. $\frac{7}{8}, \frac{2}{3}, \frac{5}{12}$
17. $\frac{5}{7}, \frac{2}{5}, \frac{11}{21}$
18. $\frac{1}{2}, \frac{7}{15}, \frac{3}{10}$
19. $\frac{7}{9}, \frac{5}{6}, \frac{1}{2}, \frac{1}{3}$
20. $\frac{1}{4}, \frac{2}{3}, \frac{11}{12}, \frac{7}{8}$
21. $\frac{1}{7}, \frac{1}{14}, \frac{1}{4}, \frac{1}{2}$
22. $\frac{5}{7}, \frac{3}{14}, \frac{3}{4}, \frac{19}{28}$
23. $\frac{1}{7}, \frac{1}{8}, \frac{1}{4}, \frac{1}{2}$
24. $\frac{3}{7}, \frac{5}{8}, \frac{3}{4}, \frac{1}{28}$
25. $\frac{1}{9}, \frac{1}{6}, \frac{1}{4}, \frac{1}{3}, \frac{1}{12}$
26. $\frac{7}{9}, \frac{2}{3}, \frac{5}{6}, \frac{7}{12}, \frac{1}{18}$
27. $\frac{3}{4}, \frac{7}{8}, \frac{12}{16}, \frac{19}{32}, \frac{1}{2}$

ADDITION OF FRACTIONS

Written

Four boys ran a relay race around the block. Their time was $\frac{1}{5}$ min., $\frac{5}{12}$ min., $\frac{1}{4}$ min., and $\frac{3}{10}$ min. How many minutes were taken for the race?

NOTE. — To find the least common denominator, try different multiples of 10, as, 20, 30, 40, etc. It will be found that 60 is the smallest multiple of 10 that will also contain 5, 12, and 4.

$\frac{1}{5} = \frac{12}{60}$
$\frac{5}{12} = \frac{25}{60}$
$\frac{1}{4} = \frac{15}{60}$
$\frac{3}{10} = \frac{18}{60}$
$\frac{70}{60} = 1\frac{10}{60} = 1\frac{1}{6}$

We reduce the fractions to fractions having their least common denominator, add their numerators, reduce the improper fraction $(\frac{70}{60})$ to a mixed number, and the fractional part $(\frac{10}{60})$ to lowest terms.

$1\frac{1}{6}$ min. *Ans.*

Add:

1. $\frac{1}{4}, \frac{1}{5}, \frac{1}{6}$
2. $\frac{1}{4}, \frac{5}{6}, \frac{7}{8}$
3. $\frac{4}{5}, \frac{4}{9}$
4. $\frac{5}{8}, \frac{9}{10}, \frac{1}{2}$
5. $\frac{3}{10}, \frac{5}{12}$
6. $\frac{3}{7}, \frac{11}{12}$
7. $\frac{1}{4}, \frac{5}{6}, \frac{7}{8}$
8. $\frac{5}{8}, \frac{9}{10}, \frac{4}{5}$
9. $\frac{3}{4}, \frac{3}{5}, \frac{9}{10}$
10. $\frac{5}{8}, \frac{7}{10}, \frac{4}{5}$
11. $\frac{14}{35}, \frac{3}{7}, \frac{2}{5}$
12. $\frac{3}{8}, \frac{1}{4}, \frac{11}{12}$
13. $\frac{15}{24}, \frac{5}{12}, \frac{1}{16}$
14. $\frac{23}{24}, \frac{5}{8}, \frac{3}{16}$
15. $\frac{2}{5}, \frac{7}{15}, \frac{4}{5}$

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ADDITION OF MIXED NUMBERS

1. Mrs. Finch bought three remnants of cloth of the following lengths: $13\frac{7}{9}$ yd., $2\frac{2}{3}$ yd., $7\frac{5}{12}$ yd. How many yards did she buy?

$13\frac{7}{9} = 13\frac{28}{36}$
$2\frac{2}{3} = 2\frac{24}{36}$ $(\frac{67}{36} = 1\frac{31}{36})$
$7\frac{5}{12} = 7\frac{15}{36}$
$22\frac{67}{36} = 23\frac{31}{36}$

We add the integers and fractions separately, and combine the sums.

$23\frac{31}{36}$ yd. *Ans.*

NOTE. — Answers should be expressed in integers or mixed numbers, if possible.

A fraction remaining in the answer should be expressed in its lowest terms.

Oral

Add:

1. $5\frac{1}{2}$, $7\frac{1}{3}$
2. $7\frac{2}{3}$, $3\frac{1}{2}$
3. $1\frac{2}{3}$, $8\frac{1}{4}$
4. $2\frac{1}{4}$, $2\frac{1}{5}$
5. $1\frac{1}{2}$, $3\frac{7}{8}$
6. $10\frac{1}{3}$, $10\frac{1}{6}$
7. $2\frac{1}{3}$, $4\frac{1}{2}$
8. $3\frac{1}{3}$, $1\frac{2}{5}$
9. $1\frac{3}{4}$, $5\frac{1}{8}$

Written

Add:

1. $6\frac{5}{7}$, $3\frac{3}{14}$
2. $18\frac{7}{15}$, $10\frac{4}{5}$
3. $23\frac{5}{18}$, $16\frac{7}{9}$
4. $2\frac{5}{12}$, $16\frac{5}{6}$, $9\frac{2}{3}$
5. $4\frac{5}{8}$, $6\frac{3}{4}$, $7\frac{1}{2}$
6. $9\frac{1}{4}$, $7\frac{3}{8}$, $9\frac{1}{6}$
7. $18\frac{3}{8}$, $29\frac{7}{10}$
8. $162\frac{5}{6}$, $3\frac{1}{2}$
9. $38\frac{7}{18}$, $14\frac{1}{8}$, $7\frac{3}{4}$
10. $13\frac{7}{20}$, $16\frac{2}{5}$, $4\frac{3}{4}$
11. $7\frac{5}{8}$, $3\frac{7}{12}$, $5\frac{2}{3}$
12. $5\frac{4}{9}$, $6\frac{3}{5}$, 19
13. $15\frac{2}{3}$, $5\frac{4}{7}$, 11
14. $19\frac{3}{4}$, $\frac{2}{5}$, $5\frac{7}{8}$
15. $16\frac{5}{6}$, $14\frac{1}{7}$, $11\frac{2}{3}$
16. $239\frac{1}{5}$, $73\frac{6}{7}$
17. $386\frac{5}{7}$, $421\frac{5}{8}$
18. $18\frac{5}{9}$, 61, $34\frac{2}{5}$

19. $2\frac{1}{3}$ yards of cloth are required for a coat, $1\frac{1}{3}$ yards for trousers, and $\frac{3}{8}$ of a yard for a vest. How many yards are required for the whole suit?

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SUBTRACTION OF FRACTIONS AND MIXED NUMBERS

Oral

1. $\frac{3}{4} - \frac{1}{4}$
2. $\frac{3}{5} - \frac{1}{2}$
3. $\frac{5}{6} - \frac{1}{3}$
4. $\frac{1}{2} - \frac{1}{6}$
5. $\frac{9}{14} - \frac{2}{7}$
6. $\frac{3}{4} - \frac{5}{8}$
7. $\frac{9}{10} - \frac{3}{5}$
8. $\frac{19}{24} - \frac{3}{4}$
9. $7 - \frac{1}{2}$
10. $8 - \frac{3}{5}$
11. $12 - 1\frac{1}{2}$
12. $22 - 1\frac{3}{15}$
13. $4 - 1\frac{1}{2}$
14. $6\frac{2}{3} - 4\frac{1}{3}$
15. $11 - 8\frac{2}{3}$
16. $19\frac{5}{7} - 9\frac{1}{7}$
17. $\frac{2}{3} - \frac{1}{4}$
18. $\frac{1}{2} - \frac{1}{3}$
19. $\frac{7}{8} - \frac{1}{2}$
20. $6 - \frac{1}{3}$
21. $3\frac{3}{4} - \frac{1}{4}$
22. $15 - 2\frac{1}{2}$
23. $10 - \frac{5}{7}$
24. $12\frac{1}{2} - 5\frac{1}{4}$
25. $8\frac{1}{2} - 4\frac{1}{4}$
26. $1\frac{7}{18} - \frac{2}{9}$
27. $\frac{3}{4} - \frac{1}{3}$

Written

From $\frac{11}{15}$ take $\frac{4}{9}$.

$\frac{11}{15} = \frac{33}{45}$

$\frac{4}{9} = \frac{20}{45}$

$\frac{13}{45}$ *Difference*

How is 45 obtained?

From $29\frac{1}{6}$ take $13\frac{7}{10}$.

$29\frac{1}{6} = 29\frac{5}{30} = 28\frac{35}{30}$

$13\frac{7}{10} = 13\frac{21}{30}$

$15\frac{14}{30} = 15\frac{7}{15}$ *Difference*

We cannot take $\frac{21}{30}$ from $\frac{5}{30}$, so we take 1 from 29, change it to $\frac{30}{30}$ and add it to $\frac{5}{30}$ making $\frac{35}{30}$.

1. Take $\frac{1}{5}$ from $\frac{5}{6}$.
2. From $\frac{19}{20}$ take $\frac{9}{11}$.
3. Find the difference between $\frac{15}{17}$ and $\frac{17}{34}$.
4. Take $91\frac{1}{5}$ from $178\frac{1}{3}$.
5. $3\frac{1}{3} - \frac{3}{5}$
6. $6\frac{1}{2} - 4\frac{2}{3}$
7. $42\frac{3}{5} - 33\frac{5}{7}$
8. $198\frac{3}{5} - 49\frac{2}{3}$
9. $3\frac{7}{8} - 2\frac{8}{9}$
10. $16\frac{2}{3} - 8\frac{5}{6}$

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11. $\frac{1}{7}-\frac{1}{8}$
12. $\frac{7}{8}-\frac{7}{12}$
13. $\frac{27}{40}-\frac{3}{8}$
14. $8\frac{1}{7}-5\frac{1}{2}$
15. $210\frac{1}{2}-109\frac{5}{9}$
16. $12\frac{1}{5}-5\frac{1}{3}$
17. $7\frac{2}{3}-5\frac{4}{5}$
18. $46\frac{3}{5}-27\frac{7}{9}$
19. $1867\frac{2}{3}-976\frac{3}{4}$
20. $32\frac{1}{3}-26\frac{5}{7}$
21. $13\frac{7}{10}-3\frac{7}{20}$
22. $481\frac{1}{15}-232\frac{7}{10}$
23. $862\frac{5}{8}-46\frac{5}{7}$
24. $230\frac{1}{2}-140\frac{3}{11}$
25. $89\frac{7}{9}-43\frac{1}{2}$
26. $807\frac{1}{17}-298\frac{1}{3}$
27. $190\frac{2}{5}-28\frac{4}{7}$
28. $281\frac{4}{11}-37\frac{1}{2}$

Practical Problems Using Fractions

Written

1. Four boys and four girls ran a relay race in solving four problems on the blackboard. This is the score:

Girls, $2\frac{1}{2}$, $\frac{5}{6}$, $2\frac{1}{3}$, $1\frac{1}{5}$ (minutes)

Boys, $1\frac{3}{4}$, $1\frac{1}{5}$, $2\frac{1}{6}$, $1\frac{4}{15}$ (minutes)

a. What was the total time of the girls?

b. What was the total time of the boys?

c. What was the difference in total time?

Without a pencil, find the difference in time on each problem. If the girls had all the answers correct and the boys had only three correct, which won?

2. When a white pine tree was cut down, the rings showed that its diameter (distance through) had increased $\frac{1}{2}$ inch in one year, $\frac{3}{4}$ inch the next, $\frac{15}{32}$ inch the next, and $\frac{7}{16}$ inch the next. What was the total increase in four years?

3. Two boards are screwed together with $1\frac{1}{4}$-inch screws. If one board is $\frac{5}{8}$ inch thick and the other is $\frac{13}{16}$ inch thick, how much will the screws lack of going through both boards?

4. In one week, during the war, the wholesale price of sugar, per pound, was raised $\frac{1}{4}$¢, $\frac{3}{8}$¢, $\frac{3}{16}$¢, and $\frac{1}{2}$¢. If the

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price was $5\frac{1}{8}$¢ before the rise, how much was it at the end of the week?

5. Doris, in tying four Christmas parcels, used $1\frac{1}{8}$ yd., $2\frac{5}{8}$ yd., $\frac{5}{8}$ yd., and $1\frac{1}{2}$ yd. of ribbon. How much ribbon did she use?

6. A screen is $\frac{7}{8}$ of an inch thick and Louis wishes to fasten upon it a hinge that is $\frac{1}{16}$ of an inch thick, using screws that lack $\frac{3}{16}$ of an inch of going through the screen. What length of screws should he use?

7. A piece of cloth that measured $35\frac{1}{2}$ yards before it was sponged, measured only $34\frac{3}{8}$ yd. after it was sponged. How much did it shrink?

8. An iron rod was $89\frac{15}{16}$ inches long. It was heated and became $90\frac{3}{32}$ inches long. How much did the length increase?

9. Henry kept a record of the time he spent in raising a crop of potatoes, and footed it up at the end of each month, as follows: May, $23\frac{1}{10}$ hr., June, $19\frac{2}{3}$ hr., July, $10\frac{1}{4}$ hr., Aug., $\frac{5}{6}$ hr., Oct., $24\frac{1}{3}$ hr. How much time did the crop require?

10. Frances canned $60\frac{5}{8}$ lb. of plums, $72\frac{3}{8}$ lb. of peaches, $45\frac{3}{4}$ lb. of cherries, and $82\frac{13}{16}$ lb. of strawberries. How many pounds of fruit did she can?

11. Herbert weighed a basket of pop corn, just from the field. It weighed $42\frac{3}{16}$ lb. After it had been dried, Harry found that it weighed only $38\frac{5}{8}$ lb. How many pounds of moisture had dried out?

12. Which would you rather have, $\frac{13}{20}$ of a dollar or $\frac{3}{4}$ of a dollar?

13. Which is heavier, $\frac{7}{8}$ of a ton of coal or $\frac{9}{10}$ of a ton of hay?

14. Make a question about $\frac{5}{8}$ of a mile and $\frac{5}{8}$ of a mile.

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Problems from Geography

LAND SURFACES IN SQUARE MILES

New York	47,620	Rhode Island	1080
Texas	262,290	Connecticut	4850
Delaware	1960	Illinois	56,000
California	155,980	Montana	145,310
New Jersey	7450	Massachusetts	8040
District of Columbia	60	Alaska	(nearly) 570,390

NOTE 1. — Water surfaces are not included in the above figures.

NOTE 2. — While answering questions 1–5, keep your geography before you, open at the map of the United States. By referring to the map, estimate each answer before computing it, and then compare your estimate with the result obtained by computation.

1. (*a*) Texas contains how many times as much land as New York? (*b*) It contains how many more square miles of land than New York?

2. Alaska would make how many states the size of New Jersey?

3. Compare, by division, the land areas of:
   - *a*. Alaska and Illinois.
   - *b*. Rhode Island and Texas.
   - *c*. Massachusetts and New York.
   - *d*. Connecticut and California.
   - *e*. Montana and Delaware.
   - *f*. Rhode Island and District of Columbia.

4. Compare, by subtraction, the land areas of:
   - *a*. Illinois and Massachusetts.
   - *b*. Texas and Alaska.

5. Find which of the columns of land surfaces indicates the greater number of square miles.

What is the difference?

Make other problems from the above table.

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Problems from a City Post Office

1. The post office in a city of 105,000 people received $525,000 in one year for stamps, registering letters, writing money orders, and other postal business. The expense of carrying on the post office was $\frac{4}{5}$ of this amount. What was the expense of carrying on the post office?

2. How much did the Post Office Department gain on account of this post office?

3. In this office 722 sacks and pouches of mail were handled in one day, each sack and pouch containing an average of 154 pieces of mail. How many pieces of mail were handled?

4. In this office there were sold in one year 12,400 twenty-five-cent stamp books; 4600 forty-nine-cent stamp books; 2250 ninety-seven-cent stamp books. How much was received for all of them?

5. In this office, 9 carriers received $800 each per year, 13 received $900 each, 18 received $1000 each, 19 received $1100 each, and 25 received $1200 each. How much was paid to all of them?

6. $101,439 was paid to 87 clerks in the office; that was how much apiece?

7. For 4 years, the receipts at this office were as follows:

1st year	$486,109.69	3d year	$539,500.98
2d year	513,668.72	4th year	544,687.25

Find the total for four years.

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Problems from the Parcel Post

The cost of sending a package by parcel post varies according to the weight of the package and the distance. Tables are furnished by the Post Office Department showing the exact cost of sending a package of any weight up to 50 pounds to any place in the country, and packages weighing more than 50 and not more than 70 pounds any distance up to 300 miles.

The table below gives the rates for 17 different weights. Add 1 cent for 25¢ and 1¢ more for each 25¢ and fraction thereof above the first 25¢, to meet the war tax of 1917. That is, if the postage, according to the table, amounts to less than 25¢, add nothing. If it is 25¢, add 1¢. If it is from 26¢ to 50¢, add 2 cents. If it is from 51¢ to 75¢, add 3 cents, and so on.

Packages weighing 4 ounces or less, 1 cent per ounce or fraction thereof to any distance.

Weight in Pounds	Local	Up to 50 Miles	50 to 150 Miles	150 to 300 Miles	300 to 600 Miles	600 to 1000 Miles	1000 to 1400 Miles	1400 to 1800 Miles	Over 1800 Miles
1	$0.05	$0.05	$0.05	$0.06	$0.07	$0.08	$0.09	$0.11	$0.12
2	.06	.06	.06	.08	.11	.14	.17	.21	.24
3	.06	.07	.07	.10	.15	.20	.25	.31	.36
4	.07	.08	.08	.12	.19	.26	.33	.41	.48
5	.07	.09	.09	.14	.23	.32	.41	.51	.60
8	.09	.12	.12	.20	.35	.50	.65	.81	.96
10	.10	.14	.14	.24	.43	.62	.81	1.01	1.20
12	.11	.16	.16	.28	.51	.74	.97	1.21	1.44
15	.12	.19	.19	.34	.63	.92	1.21	1.51	1.80
18	.14	.22	.22	.40	.75	1.10	1.45	1.81	2.16
20	.15	.24	.24	.44	.83	1.22	1.61	2.01	2.40
25	.17	.29	.29						
30	.20	.34	.34						
35	.22	.39	.39						
40	.25	.44	.44						
45	.27	.49	.49						
50	.30	.54	.54						

From this table, find the cost of sending:

1. 1 lb. 50 miles and 1 lb. 2000 miles.
2. 3 lb. 50 miles and 10 lb. 700 miles.
3. 8 lb. 1500 miles and 18 lb. 100 miles.

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4. 25 lb. local and 25 lb. 60 miles.

5. 30 lb. 40 miles and 35 lb. 140 miles.

6. 45 lb. 70 miles and 50 lb. local.

7. 15 lb. local and 18 lb. 175 miles.

8. 20 lb. 38 miles and 20 lb. 2500 miles.

9. 5 lb. 1200 miles and 3 lb. 1900 miles.

10. Two cities are 400 miles apart. To send 15 lb. by express from one to the other costs 93 cents. How much cheaper would it be by parcel post?

11. The express rate for 40 lb. between two cities 750 miles apart is 95 cents. How much less is that than the rate for two 20-lb. packages?

12. Make many other problems.

REVIEW AND PRACTICE

Oral

1. What is a fraction? If you change $\frac{3}{4}$ to eighths, how will its value be affected? How will the number of parts be changed? How will the size of the parts be changed?

2. How does $\frac{1}{2}$ compare with $\frac{1}{4}$? Show this by a drawing.

3. Which is larger, $\frac{1}{3}$ of an apple or $\frac{1}{2}$ of an apple? $\frac{6}{12}$ or $\frac{1}{2}$? $\frac{2}{3}$ or $\frac{6}{9}$?

4. Which is greater, $\frac{2}{3}$ or $\frac{3}{5}$?

5. 29 pounds are how many times 5 pounds? Compare \$250 with \$50; 1 qt. with 1 pt.; 80¢ with 20¢.

6. Compare 2 cents with 50 cents; 2 gal. with 3 gal.; 8 lb. with 64 lb.; \$.25 with \$1.50.

7. Find the cost of 24 souvenir cards at the rate of 3 for 5 cents.

8. Change to mixed numbers: $\frac{82}{9}$; $\frac{45}{8}$; $\frac{32}{9}$; $\frac{61}{3}$; $\frac{67}{12}$.

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9. Henry bought a top for 3 cents, some candy for 11 cents, and a pencil for 7 cents. What change should he receive from a quarter?

10. $240 will buy how many typewriters at $60 apiece?

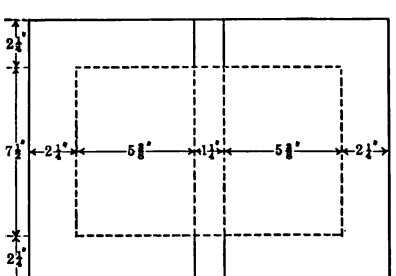
11. A windmill turned 20 times a minute. The owner oiled it and then it turned 24 times a minute with the same wind.

a. How many turns per hour were gained by oiling?

b. How many times as much work did the mill do after oiling as before oiling?

c. What part as much work did the mill perform before oiling as after oiling?

12. This is a pattern of a paper book cover. How many inches long must the sheet of paper be to make this cover?



13. How many inches wide must it be?

14. Four of these sheets cost 1 cent. What is the cost of paper for 100 covers?

15. How much does your school save by making covers for 200 books instead of buying ready-made covers at one cent apiece?

16. When $150 will buy 189 bushels of wheat, how many bushels will $50 buy? ($50 is what part of $150?)

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17. Express 54 in Roman numerals.

18. Find the cost of:

a. Three boxes of apples at 90 cents a box.

b. Four pounds of steak at 22 cents a pound.

c. Five baskets of peaches at $1.10 a basket.

19. A man received $2.40 for eight hours' work. How much did he receive for two hours' work?

20. Lucian visited his grandfather, who lived 40 miles away. What was his fare at 2½ cents a mile?

21. When a 10 lb. roast of beef costs $2.00, how much should be paid for a 5 lb. roast of the same kind?

22. Find the cost:

Of a steak at 53¢ and a roast at 90¢.

Of a hoe at 35¢ and rake at 75¢.

Of a pair of rubbers at 95¢ and tennis shoes at 85¢.

Of 38¢ worth of garden seeds and 87¢ worth of chicken wire.

Of 20 three-cent stamps and 10 two-cent stamps.

Of 1 apple when you paid 25¢ for a dozen.

Of 1 newspaper when you paid 4¢ for three papers.

23. Name all of the numbers that are exactly contained in 12; in 14; in 15; in 16; in 18.

24. Name all of the numbers of which 20 is a multiple.

25. Name all of the numbers of which 24 is a multiple.

26. Let each pupil give a problem in factors and multiples for the next pupil to answer.

27. A fraction always indicates what operation?

28. Let one pupil give a review question, and call for a volunteer to answer. Let the one who answers give the next question.

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Written

1. Two hundred railway mail clerks were paid $225,000. That was how much apiece?

2. The Post Office Department pays a rural carrier $900 a year. He sells $31.50 worth of stamps per month, and sends the money to the Department. How much less per month is received from this mail route than is paid out?

Add:

3.	4.	5.	6.	7.
$13\frac{3}{8}$	$23\frac{3}{4}$	$39\frac{7}{8}$	$61\frac{1}{2}$	$27\frac{1}{2}$
$19\frac{7}{8}$	$88\frac{3}{8}$	$52\frac{1}{4}$	$23\frac{3}{4}$	$82\frac{3}{8}$

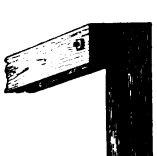
Subtract:

8.	9.	10.	11.	12.
$29\frac{3}{4}$	$41\frac{1}{2}$	$83\frac{3}{4}$	$38\frac{7}{8}$	$23\frac{5}{8}$
$8\frac{1}{8}$	$36\frac{1}{4}$	$25\frac{5}{8}$	$19\frac{1}{2}$	$15\frac{1}{4}$

13. Our city council ordered four pieces of pavement of the following lengths: $\frac{2}{3}$ mile, $\frac{7}{8}$ mile, $\frac{1}{8}$ mile, $\frac{3}{4}$ mile. How many miles of pavement were ordered?

14. Three girls brought to their sewing club these quantities of cloth: $\frac{3}{8}$ yd., $\frac{5}{6}$ yd., $\frac{2}{3}$ yd. How many yards did they bring?

15. Alvin and Joe gathered hickory nuts on four Saturdays, as follows: $\frac{1}{2}$ bu., $\frac{7}{8}$ bu., $\frac{3}{4}$ bu., $\frac{15}{32}$ bu. How many bushels did they gather?



(For the strong pupils.)

16. An iron bolt reaches through one piece of timber $7\frac{1}{2}''$ thick, another piece $5\frac{3}{8}''$ thick, and an iron collar $1\frac{1}{8}''$ thick. It extends $\frac{15}{16}''$ farther to receive the nut that holds it in place. How long is the bolt?

17. In two days a boy rode $60\frac{3}{4}$ miles on his bicycle. On the first day he rode $41\frac{1}{3}$ miles. How many miles did he ride the second day?

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PROBLEMS WITHOUT NUMBERS

We should be able to "see through" a problem and discover how to solve it, without knowing what the numbers are.

Example (*a*). Rufus earned —— cents on Monday and —— cents on Tuesday. How much did he earn in all?

Solution. — To find how much Rufus earned, add what he earned on Monday and what he earned on Tuesday.

Example (*b*). Arlene made —— cookies. She gave —— cookies to each of her —— brothers and put the others in a jar. How many did she put in the jar?

Solution. — To find the number of cookies put in the jar, multiply the number given to each boy by the number of boys; subtract the result from the number of cookies made.

Give the solutions of the following problems. First read the problem very carefully to yourself.

1. Fred sold —— copies of the *Saturday Evening Post*, Will sold ——, and Joe sold ——. How many did they all sell?

2. Mr. Robinson sold —— calves at $—— apiece. How much did he receive?

3. Mr. Felter earns $—— a year. His expenses are $——. How much does he save?

4. Mr. Burke earns $—— a year and spends (a fraction) of it. How much does he spend?

5. Mr. Jackson found —— ripe peaches on his tree. He gave —— to Mary, —— to Sue, and the rest to Robert and Earl, treating the boys alike. How many did each boy receive?

6. The product is ——. One factor is ——. What is the other factor?

7. The factors of a number are ——, ——, and ——. What is the number?

8. The sum of two numbers is ——. One of them is ——. What is the other?

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Review of Principles and Processes

1. When the parts of a number are given, how may we find the number?

2. When the factors of a number are given, how may we find the number?

3. When a product and one of its two factors are given, how may we find the other factor?

4. Upon what does the value of a figure depend?

5. How may a fraction be reduced to lower terms? Upon what principle does this process depend?

6. How may a fraction be reduced to larger terms? Upon what principle does this depend?

7. Which number used in division is always a product?

8. In division, what is known, and what is to be found?

9. In multiplication, what is known, and what is to be found?

10. How may a number be multiplied by 100 most easily? By 1000? By 200? By 60?

11. If you know the cost of 6 tons of coal, how will you find the cost of 18 tons? Of 2 tons?

12. A number that exactly contains another is called what?

13. Before eighths and thirds can be added or subtracted, what must be done to them?

14. If you know the sum of two numbers, and one of the numbers, how will you find the other number?

15. If you know the difference of two numbers, and the smaller number, how will you find the larger number?

16. If you know the difference of two numbers, and the larger number, how will you find the smaller?

17. What is cancellation?

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Quick Mental Tests

1. Add 6, 4, 7, 3, 5, 5, 9, 1, 7, 8.
2. Add 38 and 46.
3. Take 35¢ from $1. What is the change?
4. The product is 130. One factor is 13. Find the other.
5. $\frac{1}{2} + \frac{2}{3} = ?$
6. $? + \frac{1}{4} = 2\frac{1}{2}$
7. $\frac{2}{3} + ? = 1\frac{1}{3}$
8. $12 \times ? = 8$
9. $? \times 50 = 1000$
10. $? \div 8 = 9$

Short Written Tests

I. *Add, and test by adding in a different order.* (3 minutes.)

1.	2.	3.	4.
8675	$63.19	$69.34	2903
432	4.28	4.80	98
19	3.09	90.07	376
387	48.70	.86	50
6143	9.68	4.30	488
296	3.51	7.19	79
84	4.82	.86	687
489	.98	38.04	9384

II. *Subtract and test by addition:*

1.	2.	3.	4.
$457.81	$894.35	9963	4830
39.48	296.27	8972	3892

III. *Multiply and test by division:*

1.	2.	3.	4.
$83.56	4321	5076	5879
19	409	$1.28	376

IV. 1. $193\frac{7}{8} + 432\frac{1}{2}$ 2. $89\frac{5}{9} - 49\frac{2}{3}$

3. $86\frac{4}{5} = \frac{?}{5}$ 4. $\frac{7}{15} = \frac{?}{135}$

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FIFTH GRADE

SECOND HALF

Pupils entering the second half of the fifth year course are supposed to be well grounded in the four fundamental operations with integers, and in addition and subtraction of fractions. The work of the second half opens with a short review in order that new members of the class may begin the advanced work on common ground with the others, and that all may have their memory of the previous work freshened. This is especially important with classes returning to school after the long vacation. At that time, it may be desirable even to go back and repeat the last five or six pages of the previous term's work.

REVIEW OF INTEGERS

Oral

1. Read 7,640,507,239.

2. Name the periods in the above number.

3. Read CXLIV.

4. Express $\frac{236}{4}$ as an integer.

5. 35 + 48 = ? (35 + 40 = 75; 75 + 8 = 83. Say 35, 75, 83.)

In the same way add:

a. 63 and 29; *b.* 58 and 15; *c.* 49 and 33; *d.* 67 and 24.

6. The product of two factors is 45. If one factor is 9, what is the other? If one factor is 15, what is the other? If one factor is 6, what is the other?

Which of the factors given in your answer is not an integral factor?

7. The product of three factors is 108. Two of them are 4 and 3. What is the other?

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8. Find the difference by subtracting the tens first:
a. 64 − 25; *b.* 81 − 32; *c.* \$.76 − \$.28; *d.* \$1.27 − \$.79.

9. 24 × 20 = ? 30,700 ÷ 100 = ? 1200 ÷ 200 = ?

10. 235 × 1000 = ? 208 × 10 = ? 4000 ÷ 400 = ?

11. 1,500,000 ÷ 1500 = ?

12. The change for \$.24 from \$1.00 is \$.06 + \$.70 = \$.76. Say 6, 76.

Find the change from \$1.00 for:

a. \$.28 *c.* \$.18 *e.* \$.69 *g.* \$.52 *i.* \$.79 *k.* \$.72
b. \$.10 *d.* \$.42 *f.* \$.37 *h.* \$.39 *j.* \$.83 *l.* \$.35

13. *a.* One day is what part of a week? If a man pays \$84 for a week's traveling expenses, they average how much per day? *b.* At the same rate, what would they be for 11 days?

14. What part of \$5 is \$2½? If \$5 will buy 20 splint baskets, how many such baskets will \$2½ buy?

15. How many times is \$20 contained in \$400?

16. What part of \$400 is \$20?

17. A cent is what part of a dime? 7 cents are what part of a dime?

18. 6 is what part of 12?

19. When a hardware merchant makes a profit of \$1.44 on 12 window screens, what does he make on 6 of them?

20. Fred had 42 rabbits and sold ⅔ of them. How many did he sell?

21. I paid \$1 for strawberries at the rate of 3 boxes for a quarter. How many boxes did I buy?

22. Three, five, and seven are the prime factors of what number?

23. What is the smallest number that exactly contains 6 and 15?

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Written

Test, and time yourself on the first eight examples.

1. *Add:*	2. *Add:*	3. *Subtract:*	4. *Subtract:*
287	627	807,204	230,007
965	438	99,197	150,008
473	796		
287	342		
69	109		
218	781		
246	627		
968	280		
749	3578		
421	642		
372	7986		
568	8144		

5. 2059×78

6. $786 \times 205 \div 210$

7. $302 \times (4780 - 3874)$

8. $346{,}793 \div 5700$

9. A man owed his grocer \$135. He paid $\frac{2}{3}$ of the debt in labor and the rest in cash. (*a*) How much cash did he pay? (*b*) How many days did he work, if he received \$2 a day?

10. A farmer has 20 cows and feeds each of them two quarts of corn meal a day. How long will 100 bushels of corn meal last?

11. In 1914, the population of Rheims, France, was 119,898. In 1916, two years after the great war began, it was reduced to 19,983, of whom 10,012 were women, 5861 were men, and the rest children. (*a*) How many children were there? (*b*) What was the loss in population? (*c*) The population in 1914 was how many times as great as in 1916?

12. One factory makes 327 automobiles per day. At that rate, in how many days will it make 318,825 automobiles? (Estimate the answer before solving.)

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REVIEW OF FRACTIONS

Oral

Add:

1.	2.	3.	4.	5.
$3\frac{1}{2}$	$6\frac{3}{8}$	$13\frac{1}{5}$	$18\frac{3}{10}$	$6\frac{1}{7}$
7	$5\frac{1}{8}$	$10\frac{2}{5}$	$7\frac{1}{5}$	5
$2\frac{1}{4}$	$3\frac{1}{2}$	$5\frac{2}{5}$	3	$8\frac{1}{3}$

Subtract:

6.	7.	8.	9.	10.
$12\frac{7}{8}$	$5\frac{2}{3}$	$12\frac{5}{9}$	$12\frac{5}{9}$	9
$3\frac{1}{4}$	$1\frac{1}{6}$	4	$3\frac{1}{3}$	$2\frac{1}{2}$

Change to improper fractions:

11. $6\frac{1}{12}$ 12. $10\frac{3}{14}$ 13. $16\frac{2}{3}$ 14. $33\frac{1}{3}$ 15. $3\frac{17}{20}$

Reduce to lowest terms:

16. $\frac{12}{24}$ 17. $\frac{15}{18}$ 18. $\frac{22}{30}$ 19. $\frac{21}{28}$ 20. $\frac{40}{50}$

Written

Add:

1.	2.	3.	4.
$195\frac{7}{10}$	$472\frac{7}{15}$	$498\frac{3}{7}$	$644\frac{5}{14}$
$286\frac{1}{2}$	$895\frac{2}{3}$	$592\frac{11}{21}$	$482\frac{3}{7}$
$316\frac{3}{5}$	$462\frac{3}{5}$	$300\frac{1}{3}$	$691\frac{1}{2}$

5.	6.	7.	8.
$308\frac{1}{7}$	$18\frac{1}{2}$	$90\frac{1}{9}$	$35\frac{9}{12}$
$240\frac{5}{14}$	$17\frac{3}{10}$	$16\frac{1}{2}$	$16\frac{2}{3}$

Subtract:

9.	10.	11.	12.
$52\frac{1}{4}$	$856\frac{1}{2}$	$841\frac{5}{10}$	$98\frac{5}{9}$
$13\frac{3}{4}$	$109\frac{3}{4}$	$367\frac{14}{28}$	$15\frac{7}{12}$

13. The time record of a football game including stops was:

1st quarter, $14\frac{4}{15}$ minutes 3d quarter, $14\frac{3}{4}$ minutes
2d quarter, $13\frac{3}{5}$ minutes 4th quarter, $15\frac{7}{12}$ minutes
Between halves, $18\frac{2}{3}$ minutes

What was the entire time from start to finish?

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CANCELLATION

Taking a factor out of a number **divides** *the number by the* **factor taken out.**

ILLUSTRATION

a. $\frac{30}{5} = \frac{2 \times 3 \times \cancel{5}}{\cancel{5}} = 6$ *Quo.*

$30 = 2 \times 3 \times 5$. When we take out the factor 5, the factors 2 and 3 are left and their product is 6. $30 \div 5 = 6$.

b. $2730 = 2 \times 2 \times 7 \times 5 \times 13 \qquad 65 = 5 \times 13$

$$\frac{2730}{65} = \frac{2 \times 3 \times 7 \times \cancel{5} \times \cancel{13}}{\cancel{5} \times \cancel{13}} = 2 \times 3 \times 7 = 42 \quad \textit{Quo.}$$

When we take out the factors 5 and 13, the factors 2, 3, and 7 are left. Their product is 42. $2730 \div 65 = 42$.

Taking the same factors out of both dividend and divisor is **cancellation.**

Find the quotients by cancellation:

1. $\frac{2 \times 5 \times 11 \times 13}{5 \times 13} = ?$
2. $\frac{3 \times 17 \times 19 \times 2}{3 \times 19} = ?$
3. $\frac{4 \times 8 \times 9 \times 11 \times 14}{14 \times 9 \times 8} = ?$
4. $\frac{3 \times 8 \times 12 \times 13 \times 15}{15 \times 8 \times 13} = ?$
5. $\frac{21 \times 7 \times 3 \times 5 \times 6}{7 \times 6 \times 21} = ?$
6. $\frac{4 \times 31 \times 50 \times 6 \times 9}{50 \times 6 \times 4} = ?$
7. $\frac{12 \times 16 \times 3 \times 45 \times 19}{19 \times 3 \times 12} = ?$
8. $\frac{8 \times 17 \times 5 \times 6 \times 7}{5 \times 8 \times 7} = ?$
9. $\frac{7 \times 4 \times 6 \times 15}{4 \times 6} = ?$
10. $\frac{5 \times 3 \times 16 \times 14}{16} = ?$

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11. $\dfrac{\overset{6}{\cancel{12}} \times \cancel{9} \times \overset{7}{\cancel{49}} \times \overset{5}{\cancel{25}}}{7 \times \underset{9}{\cancel{18}} \times \cancel{5}} = 210$

We take the factor 2 out of 12 and 18; the factor 7 out of 7 and 49; the factor 5 out of 5 and 25; and cancel the factor 9 from both dividend and divisor. The factors remaining in the dividend are 6, 7, and 5. $6 \times 7 \times 5 = 210$. *Quotient.*

12. $\dfrac{\overset{7}{\cancel{77}}}{\underset{11}{\cancel{231}}} = 7$ *Quotient*

We take the factors 3 and 11 out of both dividend and divisor.

13. $\dfrac{\overset{5}{\cancel{25}} \times \cancel{2} \times \overset{6}{\cancel{72}} \times 14}{\cancel{6} \times 9 \times \underset{2}{\cancel{120}}} = \dfrac{70}{9} = 7\frac{7}{9}$ *Quotient*

We take the factor 12 out of 72 and 120, then the factor 5 out of 25 and 10.

14. $\dfrac{36 \times 27 \times 49 \times 50}{70 \times 18 \times 15} = ?$

15. $\dfrac{7 \times 4 \times 24 \times 2}{2 \times 7 \times 12 \times 2} = ?$

16. $(2 \times 5 \times 54) \div (10 \times 6) = \dfrac{2 \times 5 \times 54}{10 \times 6} = ?$

17. $(36 \times 48 \times 16) \div (27 \times 24 \times 8) = ?$

18. Divide $25 \times 2 \times 72 \times 14$ by $6 \times 9 \times 120$.

19. $(11 \times 3 \times 15 \times 14) \div (21 \times 11 \times 3) = ?$

20. $\dfrac{4 \times 6 \times 10 \times 20}{12 \times 25} = ?$

21. $\dfrac{8 \times 14 \times 22 \times 18}{2 \times 11 \times 7 \times 3} = ?$

22. What is the quotient of $4 \times 9 \times 17 \times 80$ divided by 17×90?

23. $(16 \times 24 \times 33 \times 34) \div (11 \times 4 \times 8 \times 17) = ?$

24. Divide $36 \times 27 \times 49 \times 38 \times 50$ by $70 \times 18 \times 15$.

25. $(28 \times 38 \times 48) \div (14 \times 19 \times 24 \times 2 \times 2) = ?$

26. What is the quotient of $36 \times 48 \times 16$ divided by $27 \times 24 \times 8$?

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MULTIPLICATION AND DIVISION COMBINED

Written

$(20 \div 4) \times (21 \div 7) = ?$

$20 \div 4 = 5$

$21 \div 7 = 3$

$5 \times 3 = 15$ *Ans.*

or, $\frac{20}{4} \times \frac{21}{7} = \frac{20 \times 21}{4 \times 7} = 15$. *Ans.*

20 and 21 are dividends and 4 and 7 are divisors. The result is the same whether we make each division separately and then multiply the quotients, or divide the product of the dividends by the product of the divisors. In many cases the latter way is easier, because we may use cancellation; *e.g.*

$$(18 \div 7) \times (28 \div 24) \times (210 \div 15) = \frac{\overset{3}{\cancel{18}} \times \overset{7}{\cancel{28}} \times \overset{42}{\cancel{210}}}{7 \times \underset{6}{\cancel{24}} \times \underset{5}{\cancel{15}}} = 42. \quad \textit{Ans.}$$

Find results:

1. $(12 \div 11) \times (22 \div 5) \times (35 \div 6) \times (15 \div 2)$
2. $(20 \div 6) \times (55 \div 10) \times (42 \div 11)$
3. $(39 \div 13) \times (35 \div 21) \times (12 \div 7) \times (21 \div 3)$
4. $\frac{42}{4} \times \frac{36}{7} \times \frac{63}{14}$
5. $(27 \div 18) \times (35 \div 75) \times (25 \div 12) \times (12 \div 7)$
6. $(68 \div 7) \times (14 \div 8) \times (35 \div 17)$
7. $(52 \div 10) \times (34 \div 13) \times (125 \div 10)$
8. $(26 \div 20) \times (68 \div 13) \times (125 \div 35)$
9. $(70 \div 17) \times (68 \div 24) \times (35 \div 7)$
10. $\frac{75}{42} \times \frac{108}{26} \times \frac{98}{15}$
11. $\frac{49}{56} \times \frac{24}{34} \times \frac{17}{5} \times \frac{20}{3}$
12. Multiply the quotient of 29 divided by 12 by the quotient of 84 divided by 29.
13. $(26 \times 5 \times 54) \div (13 \times 5 \times 6) = ?$
14. Divide $5 \times 45 \times 7 \times 20$ by $49 \times 5 \times 4 \times 9$.
15. Divide $5 \times 51 \times 7 \times 9 \times 4$ by $17 \times 20 \times 12 \times 7 \times 2$.
16. Divide $25 \times 2 \times 72 \times 14$ by $6 \times 9 \times 120$.

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MULTIPLICATION OF FRACTIONS

Written

1. Find the product of $\frac{2}{3}$, $\frac{5}{7}$, and $\frac{9}{16}$.

Each of these fractions indicates what operation?

Since all the numerators are dividends and all the denominators are divisors, we may find the result by dividing the product of the numerators by the product of the denominators, as on page 76, using cancellation:

$$\frac{\cancel{2}^{1}}{\cancel{3}_{1}} \times \frac{5}{7} \times \frac{\cancel{9}^{3}}{\cancel{16}_{8}} = \frac{15}{56}. \quad \textit{Ans.}$$

Any integer may be **expressed as a fraction** *by writing it as a numerator with* 1 *for a denominator; e.g.* 5 is the same as $\frac{5}{1}$; 19 is the same as $\frac{19}{1}$; $\frac{2}{3} \times 7 \times \frac{15}{42}$ is the same as $\frac{2}{3} \times \frac{7}{1} \times \frac{15}{42}$.

The word **of**, *between fractions, means the same as the* **sign of multiplication**; *e.g.* $\frac{2}{3}$ of $\frac{3}{5} = \frac{2}{3} \times \frac{3}{5}$; $\frac{2}{3}$ of $4 \times \frac{7}{16} = \frac{2}{3} \times \frac{4}{1} \times \frac{7}{16}$.

Find the products:

2. $\frac{3}{4} \times \frac{4}{5}$
3. $\frac{9}{10} \times \frac{5}{8}$
4. $\frac{7}{9}$ of $\frac{9}{14}$
5. $\frac{5}{6}$ of $\frac{12}{20}$
6. $\frac{7}{19} \times \frac{9}{14}$
7. $\frac{3}{4}$ of $\frac{1}{2}$ of $\frac{2}{3}$
8. $\frac{5}{6}$ of $\frac{9}{10}$ of $\frac{4}{5}$
9. $\frac{4}{9} \times \frac{3}{12} \times \frac{6}{7}$
10. $\frac{5}{16} \times \frac{8}{9} \times \frac{3}{4}$
11. $\frac{9}{25} \times \frac{10}{7} \times \frac{8}{9}$
12. $\frac{12}{17} \times 34 \times \frac{5}{8}$
13. $\frac{2}{9}$ of 15
14. $\frac{2}{5} \times 7 \times \frac{15}{42}$
15. $\frac{2}{3}$ of $\frac{3}{9} \times 14$
16. $\frac{5}{11} \times \frac{16}{15} \times 22$
17. $2 \times \frac{3}{8}$ of $\frac{7}{12}$
18. $\frac{3}{17}$ of $34 \times \frac{5}{16}$

Find the value:

19. $\frac{4}{5}$ of 40
20. $\frac{6}{7}$ of 42
21. $\frac{3}{5}$ of 16
22. $\frac{5}{8}$ of 328
23. $\frac{3}{7}$ of 721
24. $\frac{4}{5}$ of 90
25. $\frac{17}{18}$ of 342
26. $\frac{15}{16}$ of 800
27. $\frac{9}{11}$ of 2222

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Multiplication of Fractions Illustrated Graphically

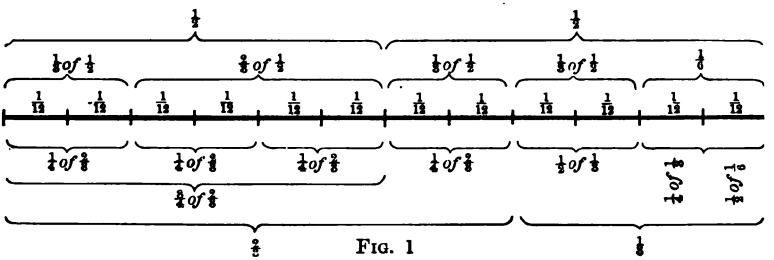

FIG. 1

Look at Fig. 1 and answer:

1. How many 12ths are there in $\frac{1}{3}$?
2. How many 12ths are there in $\frac{1}{2}$ of $\frac{1}{3}$? How many 6ths?
3. How many 12ths are there in $\frac{2}{3}$?
4. How many 12ths are there in $\frac{1}{4}$ of $\frac{2}{3}$?
5. How many 12ths are there in $\frac{3}{4}$ of $\frac{2}{3}$?
6. How many halves are there in $\frac{3}{4}$ of $\frac{2}{3}$? $\frac{3}{4}$ of $\frac{2}{3} = \frac{6}{12} = \frac{1}{2}$.
7. What else is shown in this figure?

A	B	C	D
E			

FIG. 2

Look at Fig. 2 and answer:

1. A, B, C, and D together are what part of Fig. 2?
2. A is what part of $\frac{1}{2}$?
3. A is what part of Fig. 2?
4. A and E together are what part of Fig. 2?
5. A is what part of $\frac{1}{4}$? $\frac{1}{2}$ of $\frac{1}{4}$ = ?
6. $A + B + C$ = what part of $\frac{1}{2}$? $A + B + C$ = what part of Fig. 2? $\frac{3}{4}$ of $\frac{1}{2}$ = ?

NOTE. — Feet and inches are sometimes indicated by marks, thus: 7′ stands for 7 feet; 6″ stands for 6 inches. What does $\frac{1}{8}$″ stand for? $\frac{1}{8}$′?

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From Fig. 3 answer the following questions:

1. How many parts like K are there in the square inch?

2. What part of a square inch is K?

3. What is the length of K? The breadth? The area?

4. The top row of oblongs is what part of the square inch? K is what part of that row? $\frac{1}{4}$ of $\frac{1}{8} = ?$

5. The left-hand column of oblongs is what part of the square inch? K is what part of the column? $\frac{1}{8}$ of $\frac{1}{4} = ?$

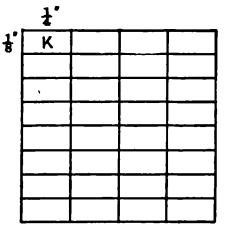

FIG. 3

In Figure 4:

1. M (the unshaded part) is how long? How wide? What is its area?

2. K is what part of the square inch? M contains how many parts like K? M is what part of the square inch?

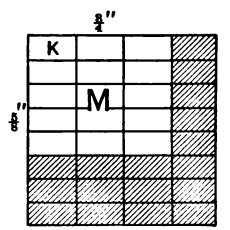

FIG. 4

What does Fig. 5 show?

Draw a square foot.

Divide two opposite sides into fourths and the other two sides into thirds. Connect the opposite division points. Show that: (*a*) $\frac{1}{3} \times \frac{1}{4} = \frac{1}{12}$. (*b*) $\frac{2}{3} \times \frac{3}{4} = \frac{6}{12} = \frac{1}{2}$. Show as many other facts as you can by that figure.

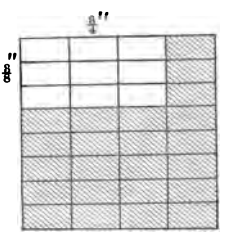

FIG. 5

TO THE TEACHER. — Many exercises similar to the preceding may be given to interest children and make the topic real to them. We must remember, however, that these are mere *graphic verifications* of the *rule* for multiplication of fractions. They neither prove nor derive the principle. The authority for every operation in fractions is found in the principles of division and the relation of dividend, divisor, and quotient.

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Oral

1. How much is $\frac{1}{2}$ of $\frac{1}{4}$ of an inch?

2. Illustrate that $\frac{1}{4}$ of $\frac{1}{2}$ of an apple is $\frac{1}{8}$ of an apple.

3. Multiply $\frac{3}{5}$ by $\frac{1}{4}$; $\frac{4}{5}$ by $\frac{1}{2}$; $\frac{1}{2}$ by $\frac{1}{3}$; $\frac{1}{6}$ by $\frac{1}{2}$.

4. How much is $\frac{1}{4}$ of $\frac{4}{7}$? $\frac{3}{5}$ of $\frac{5}{7}$? $\frac{1}{4}$ of $\frac{4}{5}$? $\frac{1}{6}$ of $\frac{6}{11} = ?$

5. A man owned $\frac{3}{4}$ of a farm and sold $\frac{1}{2}$ of his share. What part of the farm did he sell?

6. James had $\$\frac{3}{4}$, and John had $\frac{2}{3}$ as much. How much did both have?

7. If a pound of tea costs $\$\frac{3}{5}$, what will $\frac{1}{4}$ pound cost?

8. $\frac{1}{3}$ of $\frac{1}{3}$ of a square yard is what part of a square yard? Show it by a drawing.

9. Frank gave Harry $\frac{1}{2}$ of his apple and Harry gave away $\frac{2}{3}$ of his piece. What part of the apple did Harry give away?

10. Mr. Greeley, having an acre of ground, took $\frac{1}{4}$ of it for a garden. He planted $\frac{1}{3}$ of the garden in potatoes and $\frac{1}{2}$ as much in corn. What part of an acre of corn did he have?

11. My motor car uses $\frac{7}{8}$ of a gallon of gasoline in an hour. How much gasoline will it use in $\frac{3}{4}$ of an hour?

12. A party of boy scouts took $\frac{3}{4}$ of a strip of bacon when they went on a camping trip, and used $\frac{2}{3}$ of it. They used what part of a strip? What part of a strip did they bring home?

13. Inez bought $\frac{1}{4}$ of a ream of paper and gave her sister $\frac{3}{5}$ of it. What part of a ream did she give away? What part of a ream did she keep?

14. Verna served butter from a piece containing a quarter of a pound. She served $\frac{1}{12}$ of the piece to each person. What part of a pound was served to each person?

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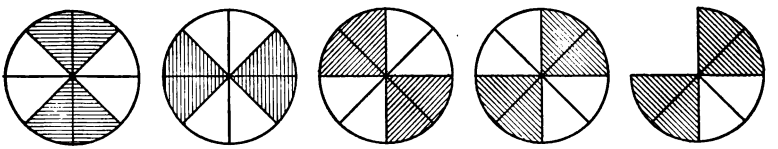
Reduction to Improper Fractions



Oral

1. How many fourths in 1 circle? In 2 circles? In 3 circles? In 4 circles?

2. How many fourths in $4\frac{3}{4}$ circles? In $3\frac{1}{4}$ circles?

3. How many eighths in 1 circle? In 3 circles? In 2 circles? In $4\frac{6}{8}$ circles? In $2\frac{3}{8}$ circles?

4. How may an integer or a mixed number be reduced to a fraction?

Reduce to fractions:

5. $1\frac{1}{3}$	8. $3\frac{4}{5}$	11. $3\frac{4}{7}$	14. $8\frac{1}{9}$
6. $4\frac{1}{2}$	9. $2\frac{3}{4}$	12. $4\frac{7}{9}$	15. $7\frac{5}{11}$
7. $3\frac{3}{8}$	10. $4\frac{3}{5}$	13. $5\frac{2}{5}$	16. $8\frac{9}{10}$

Written

1. Reduce $38\frac{7}{9}$ to a fraction.

$38\frac{7}{9} = \frac{342}{9}$. *Ans.*

$$\begin{array}{r} 9 \\ \hline 342 \\ 7 \\ \hline 349 \end{array}$$

38 = 38 × 9 ninths = 342 ninths.
342 ninths plus 7 ninths = 349 ninths.

Reduce to fractions:

2. $9\frac{3}{14}$	4. $25\frac{6}{7}$	6. $49\frac{7}{15}$	8. $59\frac{3}{14}$	10. $19\frac{7}{12}$
3. $17\frac{1}{9}$	5. $15\frac{5}{7}$	7. $25\frac{1}{30}$	9. $67\frac{5}{16}$	11. $29\frac{4}{9}$

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Mixed numbers may be reduced to improper fractions and then multiplied; thus,

$$1\tfrac{3}{3} \times 8\tfrac{1}{2} \times \tfrac{5}{17} \times 4 = \frac{5}{3} \times \frac{\cancel{17}}{\cancel{2}} \times \frac{5}{\cancel{17}} \times \frac{\overset{2}{\cancel{4}}}{1} = \frac{50}{3} = 16\tfrac{2}{3}. \quad \textit{Ans.}$$

Written

1. $4\frac{3}{4} \times 5\frac{1}{2}$
2. $35\frac{4}{5} \times 27\frac{8}{9}$
3. $11\frac{9}{11} \times 7\frac{1}{3}$
4. $28\frac{1}{2} \times 17\frac{3}{5}$
5. $177\frac{2}{3} \times 3$
6. Find $\frac{3}{11}$ of $\frac{5}{8}$ of $\frac{11}{22}$ of $8\frac{1}{5}$.
7. $4\frac{1}{2} \times 7\frac{2}{3}$
8. $\frac{3}{11} \times 25\frac{2}{3} \times \frac{5}{8}$
9. $5\frac{2}{3} \times 8\frac{6}{7} \times \frac{5}{17}$
10. $3\frac{1}{2} \times 9\frac{1}{7} \times 6\frac{5}{6}$
11. Multiply $10\frac{1}{2}$ by $\frac{2}{3}$ by $\frac{3}{7}$ by $6\frac{2}{3}$.
12. $5\frac{3}{4} \times 2\frac{4}{5} \times 20$
13. $9\frac{1}{4} \times \frac{4}{37} \times 2\frac{1}{5}$
14. $\frac{7}{16} \times 4 \times 5\frac{1}{2}$
15. $7\frac{1}{2} \times 5\frac{4}{5} \times \frac{3}{7}$
16. $6\frac{1}{4} \times \frac{11}{25} \times \frac{5}{11}$
17. $\frac{9}{10} \times 80 \times 5\frac{1}{2}$
18. Multiply $\frac{2}{5}$ by $\frac{5}{8}$ by $\frac{27}{36}$ by $\frac{81}{90}$ by $\frac{9}{21}$.
19. Mrs. A buys $3\frac{1}{2}$ qt. of milk a day. What does she pay for it at $9\frac{1}{2}¢$ a quart?
20. Show by a diagram that $\frac{1}{2}$ of $\frac{1}{3} = \frac{1}{6}$.
21. How far can Joe ride in $3\frac{3}{5}$ hours if he rides $9\frac{1}{3}$ miles an hour?
22. How many square feet of floor are there in a room $12\frac{1}{3}$ ft. by $7\frac{1}{2}$ ft.?
23. Find the value of $\frac{2}{3}$ of a chest of tea weighing $57\frac{1}{2}$ lb. at $\$\frac{3}{5}$ per pound.
24. *a.* $\frac{7}{8}$ of $\frac{5}{9}$ of $\frac{6}{7}$ of $\frac{2}{3}$ of $\frac{4}{5}$ = ?
    b. $\frac{9}{10}$ of $\frac{6}{7}$ of $\frac{11}{2}$ of $\frac{6}{11}$ = ?
25. Mr. Brown earns $\$60\frac{3}{4}$ a month, and his son earns $\frac{2}{3}$ as much. How much does the son earn?
26. At $\$12\frac{1}{2}$ a ton, how much will $9\frac{3}{20}$ tons of hay cost?

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DIVISION OF FRACTIONS

Divide $\frac{35}{72}$ by $\frac{5}{8}$.

Since $\frac{35}{72}$ is a product and $\frac{5}{8}$ is one of its factors, we may state the question thus :

$$\frac{35}{72} = \frac{5}{8} \times ? \text{ or } \frac{35}{72} = \frac{5 \times ?}{8 \times ?}.$$

In order to find the required factor we must divide the numerator 35 by 5, and the denominator 72 by 8, thus:

$$\frac{35 \div 5}{72 \div 8} = \frac{7}{9}.$$

That is exactly what we should do if the question were :

$$\frac{35}{72} \times \frac{8}{5} = ? \qquad \frac{\overset{7}{\cancel{35}}}{\underset{9}{\cancel{72}}} \times \frac{\cancel{8}}{\cancel{5}} = \frac{7}{9}.$$

The latter method is the more convenient, especially when the numerator of the divisor is not exactly contained in the numerator of the dividend, or the denominator of the divisor in the denominator of the dividend.

Therefore, *to divide by a fraction we interchange the terms of the divisor and multiply.*

Written

1. Divide $4\frac{2}{3}$ by $5\frac{3}{5}$.

Solution.— $4\frac{2}{3} \div 5\frac{3}{5} = \frac{14}{3} \div \frac{28}{5} = \frac{\overset{1}{\cancel{14}}}{3} \times \frac{5}{\underset{2}{\cancel{28}}} = \frac{5}{6}$. *Ans.*

(How do we treat mixed numbers?)

2. Divide 47 by $6\frac{1}{2}$.

Solution.— $47 \div 6\frac{1}{2} = \frac{47}{1} \div \frac{13}{2} = \frac{47}{1} \times \frac{2}{13} = \frac{94}{13} = 7\frac{3}{13}$. *Ans.*

(How do we treat integers?)

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3. $\frac{8}{11} \div \frac{4}{33}$ 9. $3\frac{1}{2} \div \frac{14}{15}$ 15. $8 \div \frac{7}{10}$ 21. $2\frac{3}{4} \div \frac{11}{12}$

4. $\frac{7}{8} \div \frac{3}{4}$ 10. $5\frac{1}{4} \div \frac{9}{20}$ 16. $10 \div \frac{5}{6}$ 22. $2\frac{1}{3} \div 3\frac{1}{2}$

5. $1\frac{1}{2} \div \frac{5}{6}$ 11. $\frac{3}{11} \div 5\frac{3}{4}$ 17. $\frac{7}{8} \div 14$ 23. $8\frac{1}{9} \div 9\frac{1}{7}$

6. $\frac{5}{18} \div \frac{3}{4}$ 12. $\frac{7}{10} \div 4\frac{1}{5}$ 18. $\frac{16}{21} \div 8$ 24. $\frac{49}{72} \div \frac{14}{27}$

7. $\frac{16}{27} \div \frac{2}{3}$ 13. $\frac{13}{15} \div 5\frac{1}{2}$ 19. $2\frac{3}{4} \div 5\frac{1}{2}$ 25. $\frac{42}{55} \div \frac{7}{11}$

8. $\frac{14}{15} \div \frac{7}{10}$ 14. $2 \div \frac{4}{5}$ 20. $7\frac{1}{8} \div 1\frac{1}{2}$ 26. $10\frac{2}{9} \div 4\frac{10}{27}$

27. By what must $\frac{24}{35}$ be multiplied to make $\frac{36}{77}$?

28. One factor of $\frac{34}{49}$ is $\frac{17}{84}$. What is the other?

29. How many pieces $\frac{7}{8}$ of an inch long can be cut from a wire that is $10\frac{1}{2}$ inches long?

30. When $2\frac{3}{8}$ lb. of beefsteak are worth $57\frac{3}{8}$ cents, what is the value of one pound?

In examples 31–46, perform the indicated divisions.

31. $\dfrac{7\frac{1}{9}}{\frac{16}{27}}$ 32. $\dfrac{15\frac{3}{4}}{4}$ 33. $\dfrac{19}{16\frac{4}{5}}$ 34. $\dfrac{3\frac{1}{2}}{\frac{7}{10}}$

35. $\dfrac{18\frac{1}{2}}{\frac{4}{5}}$ 36. $\dfrac{\frac{17}{18}}{16}$ 37. $\dfrac{\frac{7}{8}}{\frac{9}{16}}$ 38. $\dfrac{18}{\frac{9}{16}}$

39. $\dfrac{8\frac{3}{4}}{1\frac{3}{4}}$ 40. $\dfrac{12\frac{2}{3}}{3\frac{4}{5}}$ 41. $\dfrac{9\frac{2}{7}}{3\frac{3}{14}}$ 42. $\dfrac{1\frac{5}{9}}{2\frac{1}{3}}$

43. $\dfrac{9}{1\frac{1}{2}}$ 44. $\dfrac{8\frac{4}{7}}{30}$ 45. $\dfrac{12\frac{1}{4}}{2\frac{4}{5}}$ 46. $\dfrac{33}{1\frac{1}{12}}$

47. If $\frac{3}{5}$ of an acre of land is worth $\$72\frac{3}{10}$, what is the value of an acre at the same rate?

48. There are $5\frac{1}{2}$ yards in a rod. $70\frac{1}{8}$ yards equal how many rods?

49. At $\$7\frac{1}{4}$ a ton, how many tons of coal can be bought for $\$73\frac{1}{2}$?

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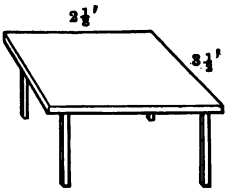
PRACTICE WITH FRACTIONS

Oral

1. Express in simplest form: $\frac{6}{10}$; $\frac{15}{3}$; $\frac{25}{8}$; $\frac{25}{50}$; $6\frac{5}{10}$; $\frac{21}{8}$; $42\frac{21}{16}$.

2. What is the area of the top of this table?



3. $\frac{2}{3}$ of $\frac{5}{8}$ = ?

4. Find the product of $\frac{3}{7}$ and $\frac{14}{27}$.

5. $? \div \frac{5}{8} = \frac{4}{5}$ $\frac{1}{8} + \frac{1}{7} = ?$ $\frac{3}{8} \div ? = \frac{4}{5}$

6. $\frac{1}{5} \times ? = \frac{1}{35}$

7. When school closed in June, Jennie weighed $61\frac{1}{2}$ lb. When school opened in September, she weighed $63\frac{5}{8}$ lb. How much did she gain during vacation?

8. The Jones Knitting Mill makes undergarments that are $\frac{3}{8}$ wool and the remainder cotton. How much smaller is the fraction that is wool than that which is cotton?

9. Rupert's uncle offered to give Rupert either $\frac{2}{3}$ or $\frac{5}{8}$ of the money he received by picking and selling strawberries from his uncle's garden. Rupert unwisely chose $\frac{5}{8}$. What part of the money did he lose by his foolish choice? How much did he lose on $12 worth of berries?

10. Maurice and Ernest rode in a bicycle race. Maurice's time was $3\frac{1}{8}$ minutes and Ernest's was $2\frac{3}{4}$ minutes. Ernest won by what part of a minute?

11. Julia bought $\frac{3}{4}$ of a pound of chocolate and used $\frac{2}{3}$ of it in making fudge. How much was left?

12. Roy gathered $2\frac{1}{8}$ bushels of chestnuts. After they were dried, there were only $1\frac{15}{16}$ bushels. How much did they shrink? (12 and 13 are for the strong pupils.)

13. A pine board just sawed from the log was $14\frac{7}{8}$ inches wide. In being seasoned and kiln-dried it shrunk $\frac{15}{16}$ of an inch. How wide was it then?

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Written

1. How much cream is there in $12\frac{1}{2}$ gallons of milk if $\frac{1}{5}$ of the whole quantity is cream?

2. Express in simplest form: (*a*) $\frac{232}{376}$; (*b*) $\frac{588}{387}$; (*c*) $\frac{240}{312}$; (*d*) $17\frac{14}{21}$.

3. Find the areas of rectangles having these dimensions:

a. $\frac{7}{8}$ in. by $\frac{5}{8}$ in.
b. $\frac{2}{3}$ yd. by $\frac{3}{4}$ yd.
c. $\frac{5}{11}$ rd. by $\frac{2}{3}$ rd.
d. $\frac{3}{4}$ ft. by $\frac{8}{9}$ ft.
e. $\frac{63}{80}$ mi. by $\frac{56}{99}$ mi.
f. $\frac{5}{11}$ mi. by $\frac{44}{45}$ mi.
g. $\frac{7}{8}$ mi. by $\frac{40}{99}$ mi.
h. $\frac{11}{15}$ mi. by $\frac{45}{88}$ mi.

4. A grocer bought 27 barrels of apples and sold $\frac{5}{9}$ of them at $\$3\frac{1}{8}$ a barrel. How much money did he receive?

5. The block in which we live contains $7\frac{1}{2}$ acres of land. Our lot is $\frac{1}{35}$ of the block. What part of an acre does our lot contain?

6. A 2-cent stamp measures $\frac{7}{8}''$ by $\frac{15}{16}''$. It occupies how much space on an envelope?

7.

2¢	2¢	2¢	2¢
2¢	2¢	2¢	2¢

Find the length, the breadth, and the area of this sheet of stamps, without measuring.

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8. How many 40ths are there in $7\frac{5}{8}$?

9. How many 99ths are there in $89\frac{6}{9}\frac{5}{9}$?

10. Find the area of both sides of a square piece of cardboard whose edge is $15\frac{3}{8}$ inches.

11. $2\frac{1}{7} \times \frac{7}{8} \div 1\frac{1}{2} = ?$

12. Multiply $\frac{1}{1}\frac{2}{7}$ by $\frac{1}{1}\frac{3}{6}$ and divide the product by $1\frac{3}{1}\frac{}{7}$.

13. *a*. $14\frac{2}{3} \div 7\frac{1}{3} = ?$ *b*. $7\frac{1}{3} \div 14\frac{2}{3} = ?$

14. $45\frac{1}{2} \div 6\frac{1}{2} - \frac{3}{8} + \frac{1}{1}\frac{}{6} = ?$

15. What is one third of one hundred seventy-five and one half?

16. The multiplicand is $1\frac{5}{1}\frac{}{8}$ and the product is $2\frac{5}{5}\frac{}{4}$. Find the multiplier.

17. How many pounds of sugar at $6\frac{1}{4}$ cents a pound will pay for $12\frac{1}{2}$ dozen eggs at 36 cents a dozen?

18. When 15 yards of silk cost $\$16\frac{7}{8}$, what is the price per yard?

19. Divide $75\frac{3}{5}$ by $14\frac{3}{7}$.

20. In one month Mr. Finlay earned $\$46\frac{3}{4}$, his wages being $\$2\frac{3}{4}$ a day. How many days did he work?

21. Divide $\frac{3}{4}$ of $\frac{2}{3}$ of $2\frac{3}{5}$ by $\frac{7}{6}$ of $\frac{2}{5}$ of 7.

22. \$75 will pay for how much corn at $\$1\frac{1}{4}$ a bushel?

23. Divide the sum of $4\frac{7}{8}$ and $5\frac{2}{3}$ by their difference.

24. If $\frac{7}{8}$ of a mile of telephone wire was divided into 14 equal pieces, how long was each piece?

25. By what must $2\frac{1}{8}$ be multiplied to obtain $2\frac{3}{7}$?

26. By what must $3\frac{3}{8}$ be divided to obtain $1\frac{4}{1}\frac{}{1}$?

27. How many aprons can be made from $10\frac{1}{2}$ yards of cloth, if $1\frac{3}{4}$ yards are enough for one apron?

28. Divide $85\frac{1}{7}$ by $14\frac{2}{3}$.

29. Tim's garden is $4\frac{2}{3}$ rd. long, and $1\frac{1}{2}$ rd. wide. Find its area.

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AVERAGES

1. Jacob weighed six of his chickens and found their weights to be 68 oz., 40 oz., 63 oz., 47 oz., 55 oz., and 70 oz. What was the average weight of the chickens?

SOLUTION

68 oz.
40 oz.
63 oz.
47 oz.
55 oz.
70 oz.
6)343 oz. *Total weight*
57½ oz. *Average weight. Ans.*

2. Harry's marks in spelling for a month were as follows:

	1st Week	2d Week	3d Week	4th Week
Monday	80	75	78	80
Tuesday	86	90	84	88
Wednesday	83	82	90	92
Thursday	88	80	86	96
Friday	92	76	90	100

a–d. Find Harry's average for each week.

e–i. Find his average for all the Mondays, all the Tuesdays, etc.

j. How much higher was his fourth week's average than his average for all the Mondays?

k. On which day of the week did he spell best?

l. What was Harry's general average for the month?

3. Our outdoor thermometer indicated the following temperatures for the mornings of last week: 76°, 82°, 80°, 67°, 60°, 70°, 81°. The week before the record was 60°, 63°, 58°, 57°, 70°, 68°, 72°. For which week was the average temperature higher, and how much higher was it?

4. The Lincoln High School football team played six games, making the following scores: 19, 7, 0, 6, 25, 19. What was the average score?

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BUSINESS OF A FRUIT STAND

1. The bunches of bananas hanging in this fruit stand contain respectively 124, 96, 63, and 140 bananas. What is the average number of bananas per bunch?

2. The two smaller bunches are red, and the bananas sell at the rate of 3 for 10 cents. What are they all worth?

3. What will the others bring at 25 cents a dozen?

4. If the four bunches were bought at $1.40 per bunch, what will be the entire profit on the sales?

5. Mr. Verona, the fruit dealer, bought 5 boxes of apples for $7.80. They average 104 apples per box. He sells them all at the rate of 2 for 5 cents.

a. What is the cost per box?

b. What is received for a box?

6. He sold a dollar's worth of pears at the rate of 3 for 10 cents. How many pears did he sell?

7. If he should put the pears in baskets, 12 in each basket, and offer them to you at 35 cents a basket, or at the rate of 3 for 10 cents, which offer would you take?

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BUSINESS PROBLEMS

1. Mr. Verona bought peaches at $1 a basket and sold them at 15 cents a dozen. There were 10 dozen in a basket. What was his profit on 5 baskets of peaches?

2. What was his profit on 50 baskets of Delaware grapes bought at $12\frac{1}{2}¢$ a basket and sold at $18¢$ a basket?

3. He bought chestnuts at $6.00 a bushel and sold them at 40 cents a quart. What did he gain on a quart?

4. Spanish shelled peanuts cost him $11.20 a sack, each sack containing 140 pounds. He sold them at 15 cents a pound. What was the profit on a sack?

5. He bought 50 watermelons at 23 cents apiece and sold them at 40 cents apiece. What was his profit?

6. He paid $8 a hundred for cantaloupes and sold them for 12 cents apiece. How much did he gain on a hundred?

7. John earned $\$6\frac{3}{4}$ one week, $\$8\frac{3}{5}$ the second, and $\$7\frac{1}{2}$ the third. What was his average earning per week?

8. How many pounds of sugar, at $7\frac{1}{2}$ cents a pound, are equal in value to $6\frac{1}{3}$ dozen eggs, at 35 cents a dozen?

9. A wheat field in the Palouse region of Washington yielded 35 bushels per acre. The total yield was 3441 bushels. How many acres did the field contain? (Estimate first.)

10. What profit does a boy make in one month if he sells 20 *Posts* a week at $5¢$ a copy and 10 *Journals* at $15¢$ a copy, when the *Post* costs $3¢$ a copy and the *Journal* $11¢$?

11. If gasoline costs $24¢$ a gallon and it takes one gallon of gasoline to run an automobile 20 miles, how much would it cost to run a distance of 120 miles?

12. What is the expense of my automobile for gasoline, oil, and repairs for three years at $25 a month?

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SEEING RELATIONS

Oral

1. 2 is what part of 6? If 6 quarts of beans cost 45 cents, what will 2 quarts cost?

2. 14 is how many times 2? What will 14 pears cost at the rate of 2 for 5 cents?

3. 18 is how many times 3? If a boy is paid 20 cents for 3 hours' work, what should he receive for 18 hours' work?

4. If a boy works 6 days to earn $4, how long should he work to earn $10?

5. What should I receive for 5 weeks' work when I earn $16 in 5 days?

6. One gallon is how many times one quart? 10 gallons are how many times 10 quarts? When 10 quarts of milk cost 60 cents, what should be paid for 10 gallons of milk?

7. If 14 five-pound jars of butter will last a family a certain time, how many ten-pound jars would last the same time?

Written

In each problem, estimate the answer first.

1. 3 is what part of 4? What should a man pay for three acres of land when 4 acres are worth $189?

2. How many bushels of wheat can be raised on 42 acres of land when 159 bushels are raised on 7 acres?

3. How many tons of hay can be bought for $3600 when 17 tons cost $300?

4. How many 10-gallon cans can be filled from a tank of oil that will fill 155 two-gallon cans?

5. Find the amount of cloth needed for 36 suits when $17\frac{2}{3}$ yd. will make 3 suits.

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Review and Practice

Oral

1. Which is greater, $\frac{5}{7}$ or $\frac{3}{4}$?

2. 3400 is the product of 100 and what other number?

3. Express $\frac{86}{10}$ in simplest form.

4. How far will a motor car run in 12 hours if it runs at the rate of 50 miles in 2 hours? (12 hr. is how many times 2 hr.?)

5. What is the smallest number that will exactly contain 3, 4, and 6?

6. $\frac{1}{2}$ of $\frac{1}{3}$ = ? $\frac{1}{2}$ and $\frac{1}{3}$ = ? $\frac{1}{2}$ less $\frac{1}{3}$ = ? $\frac{1}{2}$ times $\frac{1}{3}$ = ? $\frac{1}{2} \div \frac{1}{3}$ = ?

7. From $\frac{3}{4}$ take $\frac{2}{3}$.

8. A field of $3\frac{7}{8}$ acres was planted in corn and potatoes. There were $1\frac{3}{4}$ acres of potatoes. How many acres of corn were there?

9. A lady went shopping with \$10. After spending $\$3\frac{3}{4}$ in one store and $\$5\frac{1}{2}$ in another, how much money had she?

10. Change $\frac{12}{18}$ to a fraction whose terms are prime to each other.

11. Change $4\frac{1}{3}$ to a fraction.

12. Find the value of $\frac{21}{5}$.

13. My mother paid 8 cents for one melon, 7 cents for another, and 10 cents for another. What was the average cost?

14. Show by means of a circle that $\frac{1}{2}$ of $\frac{1}{3} = \frac{1}{6}$.

15. What will it cost to send 10 lb. by parcel post from Portland to Spokane at the rate of 7¢ for the first pound and 4¢ for each additional pound plus 2¢ war tax?

16. A bookkeeper earning \$120 a month uses $\frac{1}{4}$ of it to buy food and $\frac{1}{8}$ of it to pay rent. How much has he for other uses?

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Written

1. Draw a clock face, using Roman numerals. Let the hands indicate a quarter past 9.

2. Find the wages of 8 men for $5\frac{3}{4}$ days at $\$3\frac{1}{2}$ a day.

3. A watch gains $1\frac{1}{2}$ seconds every day. How many minutes does it gain in the months of June and July?

4. There are 609 pupils in a school, $\frac{4}{7}$ of whom are girls. How many are boys?

5. A man spent $\frac{2}{3}$ of his money and had \$60 left. How much had he at first? (\$60 is what part of his money?)

6. *a.* $15\frac{3}{8} \times 16\frac{7}{8} = ?$ *b.* $16\frac{2}{3} \div 33\frac{1}{8} = ?$ *c.* $5\frac{3}{8} \div 1\frac{1}{3} = ?$

7. $(2\frac{1}{2} + \frac{6}{7} + 3) \div \frac{3}{5} = ?$

8. If $6\frac{1}{4}$ bu. of rye cost $\$8\frac{3}{4}$, what does 1 bushel cost?

9. Here are the standings of seven girls in three tests:

	Marion	Frances	Dorothy	Helen	Jessie	Hazel	Ruth
Arithmetic,	70	93	98	92	70	83	95
Geography,	93	90	76	98	90	84	80
Spelling,	95	88	95	79	96	85	76

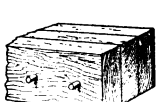
a. Which girl has the highest average?

b. What is the average of the class in spelling? *c.* In arithmetic? *d.* In geography?

e. Find the difference between Marion's average and Hazel's. *f.* Between Ruth's and Jessie's.

g. Find the general average of the class.

h. Find the difference between Helen's average and the average of the class.



10. A girder is made by bolting together three planks whose thicknesses are $1\frac{3}{4}$ in., $2\frac{15}{16}$ in., and $1\frac{7}{8}$ in. The bolts extend $1\frac{3}{8}$ in. beyond the plank to receive the nut. How long are the bolts?

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WHEN ONE FACTOR IS A MIXED NUMBER

The method of multiplication given on p. 77 is always sufficient wherever fractions or mixed numbers are concerned. Time may be saved, however, where one factor is an integer and the other a mixed number, and either factor a large number, by the following method:

1. A bale of cotton weighs $543\frac{7}{8}$ lb. How much will 19 such bales weigh?

$543\frac{7}{8}$
19
$16\frac{5}{8}$
4887
543
$10333\frac{5}{8}$

$\frac{19}{1} \times \frac{7}{8} = \frac{133}{8} = 16\frac{5}{8}$.
We multiply $\frac{7}{8}$ by 19 and add the result to 19 times 543.
10,333⅝ lb. *Ans.*

2. Mr. Doyle receives 65 cents an hour for his work. How much does he receive for $5\frac{3}{4}$ hours' work?

$\frac{65}{1} \times \frac{3}{4} = \frac{195}{4} = 48\frac{3}{4}$.
We multiply \$.65 by $\frac{3}{4}$ and add the result to 5 times \$.65.

\$.65
$5\frac{3}{4}$
$48\frac{3}{4}$
325
Ans. \$3.73¾

Multiply

1. $79\frac{3}{7}$ by 5	**2.** $88\frac{3}{22}$ by 6	**3.** $126\frac{7}{9}$ by 8	**4.** $532\frac{11}{14}$ by 9
5. 388 by $16\frac{1}{3}$	**6.** 805 by $21\frac{5}{7}$	**7.** 89 by $36\frac{5}{11}$	**8.** 178 by $13\frac{5}{8}$
9. 815 by $36\frac{5}{6}$	**10.** 91 by $97\frac{6}{7}$	**11.** 346 by $48\frac{7}{9}$	**12.** $77\frac{6}{11}$ by 36

13. Mr. Jacobson owns 11 city lots, each having a frontage of $66\frac{2}{3}$ feet. What is the total frontage of the lots? (Estimate first.)

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MEASUREMENTS

TABLE OF LIQUID MEASURE

4 gills (gi.)	= 1 pint (pt.)
2 pints	= 1 quart (qt.)
4 quarts	= 1 gallon (gal.)

Oil, vinegar, molasses, and other liquids are shipped in barrels or casks of various sizes. But for the purpose of indicating the capacities of vats, tanks, reservoirs, etc., 31½ gallons are called a *barrel* (bbl.) and 63 gallons a *hogshead* (hhd.).

Oral

1. At 4¢ a pint, what will 6 qt. of milk cost?
2. 4 gal. 2 qt. = —— qt.
3. 1 qt. is what part of a gallon?
4. 63 qt. are how many gallons?
5. If 1 qt. of syrup can be made from 20 ounces of maple sugar, how many ounces of sugar will make 1 gal. of syrup?
6. ½ of a hogshead is how many gallons?
7. How many gallons are there in 50 quarts, and how many quarts are left over?

Written

1. A grocer bought a barrel of apple juice and put it into quart bottles. How many bottles were filled? (Estimate first.)
2. A grocer bought vinegar at $7 a barrel and sold it at 15¢ a quart. Allowing one gallon for waste, how much did he gain on the barrel?
3. Oil bought at $2 a barrel and sold at 40 cents a gallon yields what profit per barrel?

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TABLE OF DRY MEASURE

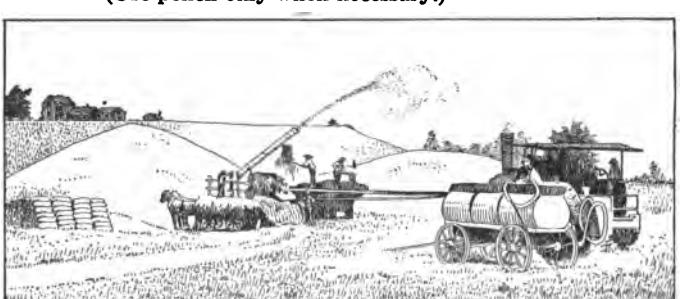
2 pints (pt.)	**= 1 quart (qt.)**
8 quarts	**= 1 peck (pk.)**
4 pecks	**= 1 bushel (bu.)**

Many commodities which were formerly bought and sold "in bulk" and measured by the quart, peck, or bushel, are now bought and sold by the box, case, crate, or package, these receptacles being of uniform or standard dimensions. But little time should be given to drill upon this table.

1. How many quarts are there in one bushel?

2. How many bushels of apples at 25¢ a peck can be bought for $20?

Written (Use pencil only when necessary.)



1. This threshing-machine threshed 40 sacks of wheat in one hour. Twenty of them were weighed and found to contain 25 bu. of wheat. What was the average number of bushels in a sack?

2. How many bushels were threshed in an hour?

3. How many bushels can be threshed in a 12-hour day, at that rate?

4. On a field of 110 acres 1100 sacks of wheat were threshed. That was how many bushels per acre?

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TABLE OF AVOIRDUPOIS WEIGHT

16 ounces (oz.)	= 1 pound (lb.)
2000 pounds	= 1 ton (T.)
2240 pounds	= 1 long ton
100 pounds	= 1 hundredweight (cwt.)

The term *hundredweight* is used less than formerly, although its value (100 lb.) is still taken as a unit in quoting freight rates and prices of various articles, when the quantity used makes this a convenient unit of weight.

The *long ton* is used in wholesaling certain mining products.

The ton of 2000 lb. is sometimes called a *short ton*.

Oral

1. How many ounces are there in 1 cwt.?
2. 500 lb. is what part of a ton?
3. What will 500 lb. of hay cost at $18 per ton?
4. $1\frac{1}{2}$ is what part of $9?
5. How many pounds of coal at $9 a ton will $1\frac{1}{2}$ buy?
6. How many 4-ounce packages can be made from $1\frac{1}{2}$ lb. of candy?
7. At 64¢ a pound, what will 4 oz. of tea cost?
8. At a church supper 88 people were served with coffee. Allowing $\frac{1}{2}$ oz. for each person, how many ounces of coffee were used? How many pounds? What did it cost at 40¢ per pound?
9. At $1.50 per cwt., what is the freight charge on $\frac{1}{2}$ ton of furniture?
10. How many 50 lb. sacks of rock salt will make one ton? What will 20 sacks cost at $1.20 per cwt.?

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Written

1. Smith & Co. gave away 312 lb. 8 oz. of salt in one-ounce packages. How many packages did they give away?

312 (lb.)
16 (oz.)
1872
312
4992 (oz.)
8
5000 oz. *Ans.*

In 312 lb. there are 312 × 16 oz., or 4992 oz.
4992 oz. + 8 oz. = 5000 oz. *Ans.*

2. How many hundredweight and how many pounds over are there in a load of potatoes weighing 3874 lb.?

100)3874
38 cwt. 74 lb. *Ans.*

3874 lb. are as many hundredweight as the quotient of 3874 ÷ 100, or 38 cwt., and 74 lb. remaining.

TO THE TEACHER. — Reduction "ascending and descending" is practically a thing of the past. Except in longitude and time, denominate numbers are seldom expressed in more than two denominations, and the pupil's facility in the ordinary processes of multiplication and division should be sufficient for the performance of any one-step reduction required in the usual course of business.

3. Mr. Marr bought a carload of sugar containing 453 sacks, each holding 1 cwt. of sugar. How many tons of sugar did he buy, and how many hundredweight over?

4. Mr. Marr paid $7.10 per cwt. for the sugar, and retailed it at 8¢ per lb. (*a*) What did he gain on one sack? (*b*) On the entire carload?

5. The car in which the sugar was shipped was labeled, "Capacity 80,000 lb." (*a*) How many tons could the car carry? (*b*) The load of sugar was how many tons less than the capacity of the car?

6. 138 pieces of mail in a pouch weighed 60⅜ lb. How many ounces in weight did the pieces average?

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TABLE OF LINEAR MEASURE

12 inches (in.)	= 1 foot (ft.)
3 feet	= 1 yard (yd.)
$5\frac{1}{2}$ yards, or $16\frac{1}{2}$ feet	= 1 rod (rd.)
320 rods	= 1 mile (mi.)

Oral

1. How many inches in 1 yd.? In 10 yd.?

2. 10 rods are how many feet?

3. How many rods are there in the perimeter of a lawn that is 33 feet square?

4. Draw on the blackboard a line 1 yd. long, using no measure. Measure and correct it. On your paper draw a line $3\frac{1}{2}$ in. long, using no measure. Measure and correct it.

5. Estimate the length and breadth of your schoolroom. Test your estimates by measuring.

6. How many feet high do you think your schoolroom is? Can you find a way to measure it without climbing? Measure it, and see how nearly correct your estimate is.

7. If you go 30 inches at a step, how many steps will you take in going 30 feet?

8. A row of corn contains five hills to a rod. How many hills are there in a row a quarter of a mile long?

9. How many feet does a boy run in a 100-yard dash?

10. Henry's record in a running high jump was 4 ft. 11 in. How many inches was it?

11. In one place, the German trenches were 125 yards from the British trenches. How many feet apart were the trenches?

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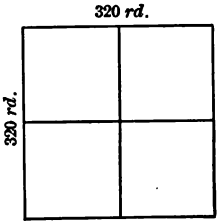
DRAWING TO A SCALE

1. This oblong represents a field. $\frac{1}{8}$ inch stands for 1 rod. Measure the sides, and tell how many rods long and how many rods wide the field is.

2. Draw on the blackboard a plan of your schoolroom floor, using $\frac{1}{2}$ inch for 1 foot; that is, draw the floor to the scale of $\frac{1}{2}''$ to $1'$.



3. This square represents a square mile. Can you tell what the scale is?

Each small square is what part of a square mile?

How many rods of fence would be needed to inclose a square field containing $\frac{1}{4}$ of a square mile?

4.

The width of this floor is 16 ft.
Can you find the scale of this plan?

What is the length of one long side?
What is the greatest length of the room?

5. Maps are drawn to a scale. Look at your geography and find out the scales to which the maps are drawn.

6. Suppose you are drawing a plan of a barn which is 40 ft. long and 30 ft. wide, using the scale $\frac{1}{8}'' = 1'$. How long and how wide will your plan be?

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LINEAR MEASURE

Written

1. A running course is 412 yd. 2 ft. in length. How many feet long is it?

412 (yd.)
3 (ft.)
1236 ft.
2
1238 ft. *Ans.*

412 yd. = 412 × 3 ft., or 1236 ft.
1236 ft. + 2 ft. = 1238 ft. *Ans.*

2. A field is 40 rd. 7 ft. long. How many feet long is it?

$16\frac{1}{2} \times 40 = \frac{33}{\cancel{2}} \times \frac{\overset{20}{\cancel{40}}}{1} = 660$. 660 ft. + 7 ft. = 667 ft. *Ans.*

NOTE. — Remember that lengths are seldom given in more than two denominations. It is a waste of time to make reductions of more than one step.

Distances are given in rods and feet rather than in rods and yards.

3. How many miles are there in 8765 rd., and how many rods over?

27 mi. 125 rd. *Ans.*

320)8765
64
236
224
12

We divide the number of rods given by the number of rods in 1 mile. The quotient is 27, or the number of miles, and the remainder is 125, or the number of rods over.

4. How many rods are there in 183 feet?

$\frac{183}{1} \div 16\frac{1}{2} = \frac{183}{1} \div \frac{33}{2} = \frac{\overset{61}{\cancel{183}}}{1} \times \frac{2}{\underset{11}{\cancel{33}}} = \frac{122}{11} = 11\frac{1}{11}$ rd. or

$\frac{1}{11}$ rd. $= \frac{1}{\cancel{11}} \times \frac{\overset{3}{\cancel{33}}}{2} = 1\frac{1}{2}$ ft.

11 rd. $1\frac{1}{2}$ ft. *Ans.*

In actual business there is little occasion to change feet to rods. Whenever that is necessary, it is best to use the common fraction method shown above.

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5. A tree 39 ft. 8 in. long was washed ashore at our summer camp. Herbert and Hiram sawed it into 16-inch lengths for the stove. How many lengths were there?

6. How many feet are there in a mile?

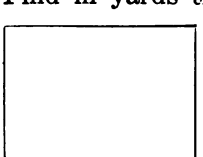
7. A boy ran 24 times around a 200-foot track in a gymnasium. How much less than a mile did he run?

8. How many inches apart are the hills of corn in a row where they average 5 hills of corn for every rod?

Find the number of:

9. Inches in 28 ft. 7 in.
10. Rods in 5 mi. 38 rd.
11. Feet in 378 yd. 1 ft.
12. Feet in 30 rd. 5 ft.
13. Feet and inches in 897 in.
14. Yards and feet in 295 ft.
15. Miles and rods in 9837 rd.
16. Rods and feet in 539 ft.
17. Rods and feet in 832 ft.
18. Feet in 47 rd. 2 ft.
19. Feet in 86 yd. 2 ft.

20. The sum of all the sides of a figure is its perimeter. Find in yards the perimeter of a square park of which each side is 107 feet.



21. (For the strong pupils.) This is the plan of a schoolroom. The scale is 4 ft. to $\frac{1}{8}$ in. Can you find the perimeter of the room?

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TABLE OF SURFACE MEASURE

144 square inches (sq. in.)	= 1 square foot (sq. ft.)
9 square feet	= 1 square yard (sq. yd.)
$30\frac{1}{4}$ square yards	= 1 square rod (sq. rd.)
160 square rods	= 1 acre (A.)
640 acres	= 1 square mile (sq. mi.)

In the practical uses of surface measure, no reductions of more than one step are required. The reductions most used are: (*a*) those involving square yards and square feet, and (*b*) those involving acres and square rods. There is no demand for reductions involving square yards and square rods.

The most important consideration is that pupils have exact mental pictures of the several units. Pupils should do much estimating and measuring of surfaces within easy reach.

Oral

1. Without a measure draw a square inch. Measure and correct it.

2. Without a measure draw on the blackboard a square foot and a square yard. Measure and correct them. Divide the square yard into square feet. Divide the square foot into square inches.

3. How many square inches are there in two square feet?

4. Estimate the number of square yards in the floor of your schoolroom. Measure it, and see how nearly right your estimate is. Make an estimate of the area of each wall, and test it by measuring. Measure your school lot, and find what part of an acre it contains.

5. How many square inches are there in $\frac{1}{2}$ sq. ft.?

6. A 5-inch square contains how many square inches? Draw it.

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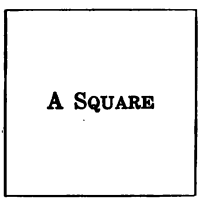
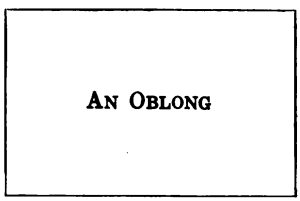
When two lines meet so as to make a "square corner," they form a **right angle.** This is a right angle: ⌊

RECTANGLES





1. How many right angles has the square? How many sides?

2. How many right angles has the oblong? How many sides?

A figure that is bounded by four straight sides and has four right angles is a **rectangle.**

3. All squares are rectangles. All oblongs are rectangles. What is the difference between a square and an oblong?

4. What kind of figure is the floor of your schoolroom? The ceiling?

5. The side wall? The blackboard? The door?

6. Name other rectangles.

7. Draw on your paper a rectangle five inches long and one inch wide. Divide it into square inches. How many square inches are there?

8. Draw a rectangle five inches long and three inches wide.

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9. Draw lines dividing it into square inches. How many square inches are there in one long row? How many rows?

10. How many square inches in all? (3×5) sq. in. are 15 sq. in.

11. On the schoolroom floor draw a rectangle 5 ft. long and 3 ft. wide. Draw lines dividing it into square feet? How many are there? (3×5) sq. ft. are 15 sq. ft.

The number of square inches, square feet, square yards etc. that a rectangle or other figure contains is its **area.**

12. What is the area of a rectangle 9 in. by 7 in.?

13. What is the area of a rectangle 10 ft. long and 8 ft. wide? Of a lawn that is 5 rd. long and 4 rd. wide?

TO THE TEACHER. — In the grades below the fifth, much work has been done upon the fundamental idea of computing area. Diagrams have been made showing the *number* of square units to be equal to the product of the *numbers* of linear units in the length and breadth.

It would be well for the teacher to present the idea again here, in the same manner, although children should be able, by this time, to use the process understandingly as presented, just as they multiply by a number of three figures without analyzing the process every time.

The **area** *of a rectangle is found by* **multiplying its length by its breadth,** *both expressed in the same kind of units.*

Written

1. How many acres are there in a rectangular field 40 rd. long and 28 rd. wide?

28 (rd.)
40 (rd.)
160)1120 (sq. rd.)(7 A. *Ans.*
112

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Such problems may be shortened by cancellation, thus:

$$\frac{\overset{7}{\cancel{28} \times \cancel{40}}}{\underset{4}{\cancel{160}}} = 7 \text{ acres.} \quad \textit{Ans.}$$

The number of square rods is 28×40.
The number of acres is $28 \times 40 \div 160$.

2. How many square yards are there in a piece of pavement 300 feet long and 38 feet wide?

$$\frac{38 \times \overset{100}{\cancel{300}}}{\underset{3}{\cancel{9}}} = \frac{3800}{3} = 1266\tfrac{2}{3} \text{ sq. yd.} \quad \textit{Ans.}$$

The number of square feet is 38×300.
The number of square yards is $38 \times 300 \div 9$.

NOTE. — Areas are seldom expressed in two denominations, but rather in an integer or a mixed number of one denomination. For instance, the area in problem 2 is $1266\frac{2}{3}$ sq. yd. rather than 1266 sq. yd. 6 sq. ft.

3. How many square feet of surface are there in a table top that is 2 ft. wide and 3 ft. 4 in. long?

4. A square mile of land is called a section. How many acres are there in a quarter section? In $\frac{1}{8}$ of a section?

5. *a.* A school garden 4 rd. by 8 rd. contains how many square feet of land? (First change the dimensions to feet.)

b. In this garden, 612 sq. ft. were given up to paths, rose beds, and other permanent uses. How many square feet were left for other uses?

c. How many square yards were left?

6. Mrs. Brown's guest room is 20 ft. 6 in. long and 16 ft. wide.

a. How many square feet of hardwood floor does it require?

b. How much will the floor cost at 18¢ a square foot?

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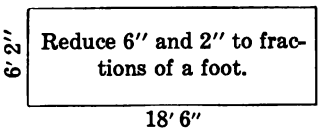
7. This is a hall floor. How many square feet of floor does it contain?

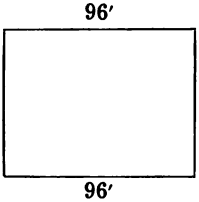


8. The floor of Howard's room has an area of 168 sq. ft. It is 12 ft. wide. How long is it?

12 × length = 168.

168 is a product; 12 is one of its factors. How will you find the other factor?

9. A department store in our city has 28,800 sq. ft. of floor space on each floor. It is 120 ft. wide. How long is it?



10. This represents the floor of our gymnasium. Area 6912 sq. ft. Find its width.

11. A 10-acre field is 50 rd. long. How wide is it?

(Since there is no denomination in linear measure that corresponds to acres, first reduce 10 acres to square rods.)

12. Our manual training shop is 14 yd. long and 11 yd. wide. The eighth-grade boys put a concrete floor in the basement. How much would it have cost at 10¢ a square foot?

Find the missing numbers belonging to these rectangles:

	Length	Breadth	Area
13.	42′	29′ 8″	?
14.	32 yd.	27′	?
15.	24 rd.	?	3 A.
16.	?	17 yd.	3060 sq. ft.
17.	18″	?	2 sq. ft.
18.	20 rd.	99 yd.	?

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Review and Practice

Oral

1. Edward earned \$3 in one week and \$6 the next. How much money was left after he had used $\frac{2}{3}$ of it?

2. When $16\frac{1}{2}$ gallons of molasses cost $\$16\frac{1}{2}$, what is the cost per quart?

3. Mr. McCrea bought an acre of land and cut it into 5 lots of equal size. How many square rods were there in each?

4. Name two numbers that are prime to each other.

5. Change $\frac{2}{3}$ to 9ths.

6. Change $\frac{14}{21}$ to a fraction whose terms are prime to each other.

7. What is the smallest number that will exactly contain 8 and 12?

8. 16 is the sum of $10\frac{5}{7}$ and what other number?

9. Esther spent 5 cents for carfare, 4 cents for pencils, 8 cents for paper, 10 cents for ribbon, and 15 cents for lunch. She had 9 cents left. How much money had she at first?

10. A man in repairing his house paid \$65 for lumber, \$8 for paint, \$1 for nails, and \$30 for labor. What was the cost of his repairs?

11. How many rods are there in 2 mi.?

12. 12 yd. 2 ft. = —— ft.

13. Name 3 factors of 30.

14. Name all the numbers that are factors of 24.

15. If a bushel of oats weighs 32 lb., what is the weight of $3\frac{1}{2}$ pk.?

16. Alma made a tray cloth $\frac{7}{8}$ of a yard long and $\frac{5}{8}$ of a yard wide. What part of a square yard will it cover?

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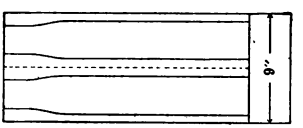
17. Clarence made a jelly-squeezer for his mother. He found a board 2 ft. long and cut off $3\frac{5}{8}''$. How long was the piece remaining? It was 9″ wide. He sawed it lengthwise, making two equal pieces, then planed them down so that each piece was $4\frac{1}{8}''$ wide. How much of the width of each piece was wasted? He whittled down one end of each piece for a handle, laid one piece upon the other, bent a piece of tin over the remaining ends for a hinge, so that it extended back $3\frac{1}{4}''$ on the outside of each piece, and nailed it to both pieces. The boards were $\frac{7}{8}''$ thick. How long was the piece of tin?



18. *Give sums rapidly:*

$\frac{1}{2}$	$\frac{2}{3}$	$\frac{3}{4}$	$\frac{5}{6}$	$\frac{2}{3}$	$\frac{3}{8}$
$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$

19. Subtract the fractions as given in question **18.**

20. $\frac{2}{3}$ of $1\frac{1}{2} = ?$ $\frac{5}{8}$ of $\frac{3}{5} = ?$ $\frac{1}{3}$ of $\frac{3}{5} = ?$

21. $\frac{9}{10} \div 3 = ?$ $\frac{2}{5} \div \frac{1}{2} = ?$ $\frac{3}{4} \div \frac{3}{5} = ?$

22. $\$\frac{1}{4} + \$\frac{1}{2} + \$\frac{1}{10}$ = how many cents?

23. Larry paid 10¢ for 4 apples. What would a dozen cost at the same rate? (12 = how many times 4?)

24. When oranges are 40¢ a dozen, what should be paid for three? (Three = what part of a dozen?)

25. When tomatoes are $1.50 a dozen cans, what should I pay for 6 cans?

26. Mary bought 18 inches of cloth from a piece that sold at $1 a yard. What did she pay?

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Written

1. Find in feet the perimeter of a figure whose sides are 39 inches, 45 inches, 28 inches, 56 inches, 75 inches, and 17 inches.

2. One factor of 8987 is 19. What is the other?

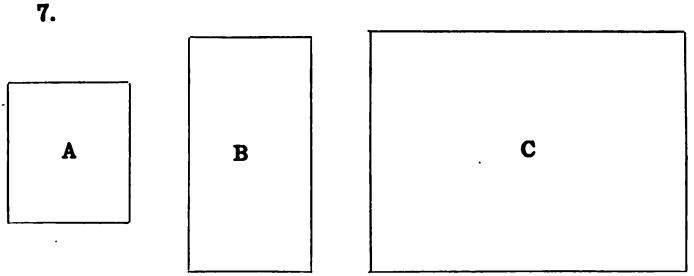
3. How many rods are there in the perimeter of a lawn that is 33 feet square?

4. Mr. Rothrock shipped from Clarkia, Idaho, to Chicago 30 carloads of lambs. There were 13,500 lambs in all. What was the average number per car?

5. If the lambs weighed 75 lb. apiece, how many tons did they all weigh?

6. They were sold in Chicago at $12\frac{1}{4}¢$ per pound. How much per ton was that?

7.



The scale of these plans is 16′ to 1″. Find the perimeter and area of the surface represented by each.

8. Reduce $365\frac{1}{4}$ and $66\frac{2}{3}$ to improper fractions.

9. Reduce $\frac{72}{144}$ to lowest terms.

10. How many 15ths are there in 39?

11. Find the value of $\frac{500}{29}$; $\frac{625}{37}$; $\frac{481}{19}$.

12. How many 40ths are there in $7\frac{5}{8}$?

Reduce to lowest terms:

13. $\frac{728}{784}$ 14. $\frac{120}{216}$ 15. $\frac{245}{385}$ 16. $\frac{42}{140}$ 17. $\frac{150}{900}$

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PROBLEMS ON FOOD

(For strong pupils)

1. These loaves of bread are $11\frac{1}{4}$ inches long. The blade of the bread cutter revolves so as to cut off a slice of bread at every turn of the wheel.

a. If the slices are $\frac{5}{16}$ in. thick, how many inches of the loaf will be cut off by 18 turns of the wheel?

b. How many inches will be left?

c. How many turns are made in cutting an entire loaf?

d. How many slices can be cut from one loaf?

2. A loaf of this bread is made into sandwiches. The slices are $\frac{5}{16}$ in. thick. The end crusts are not used for this purpose. Each sandwich is made of two slices of bread and $\frac{1}{2}$ ounce of meat that costs 32¢ a pound. The bread costs 10¢ a loaf.

a. How many sandwiches are made?

b. What is their entire cost?

c. If they are sold at 5¢ apiece, what is the profit on all of them?

3. There are 90 loaves of bread in the picture.

a. If they are $11\frac{1}{4}$ in. long and cut into slices $\frac{5}{8}$ in. thick, how many slices are there?

b. If the bread costs 10¢ a loaf and all except the end crusts is served at a lunch counter at 2¢ a slice, what is the profit on all of it?

c. The 90 loaves would make how many slices $\frac{3}{8}$ in. thick?

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VOLUME MEASURE

Thus far we have studied the measurement of lines and distances (linear measure) and the measurement of surfaces (surface measure). Lines have only length. Surfaces have length and breadth. We shall now study the measurement of things that have length, breadth, and thickness, as a cake of ice, a brick, a mass of earth, a piece of wood.

Name other objects that have length, breadth, and thickness.

We call these **solids.** That does not mean that they are heavy like iron, nor that they are hard like wood, nor that we cannot see through them nor pass through them. Your schoolroom is a solid, because it has length, breadth, and height (thickness). An empty box is a solid because it has length, breadth, and height (thickness). A toy balloon is a solid, because it has length, breadth, and height (or thickness). Length, breadth, and thickness (or height) are called **dimensions.**

A **line** has only one dimension. What is it?

A **surface** has two dimensions. What are they?

A **solid** has three dimensions. Name them.

You know a **cube** when you see it. Take a cube in your hand. How many surfaces (or faces) has it? What is their shape?

> *A solid that is bounded by six square faces* is a **cube.**

Take an inch cube in your hand. How many surfaces has it? What is each surface?

> *A cube whose edge is one inch* is a **cubic inch.**

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Can you tell what a cubic foot is?

Can you think of some object about as large as a cubic foot?

Show with your hands the length, breadth, and height of a cubic foot.

Show how high a cubic foot would be if it were lying on your desk. Show how wide and long it would be.

A cube whose edge is one foot is a **cubic foot.**

Can you tell what a cubic yard is?

Show how high a cubic yard would be if it stood on the floor by your side.

Could a cubic yard be put through the open door or window of your schoolroom? Measure and see.

A cube whose edge is one yard is a **cubic yard.**

All cubes are rectangular prisms.

A rectangular prism need not have square surfaces. An ordinary pasteboard box or dry-goods box is a rectangular prism. Is a piano-box a rectangular prism? Why not?

A solid bounded by six rectangles is a **rectangular prism.**

Tell which of the following figures are rectangular prisms:

A cake of ice; a brick; a log; an orange; a domino; a football; a suitcase; an ink bottle; a potato; a schoolroom; a crayon box; a hat box; a water pail.

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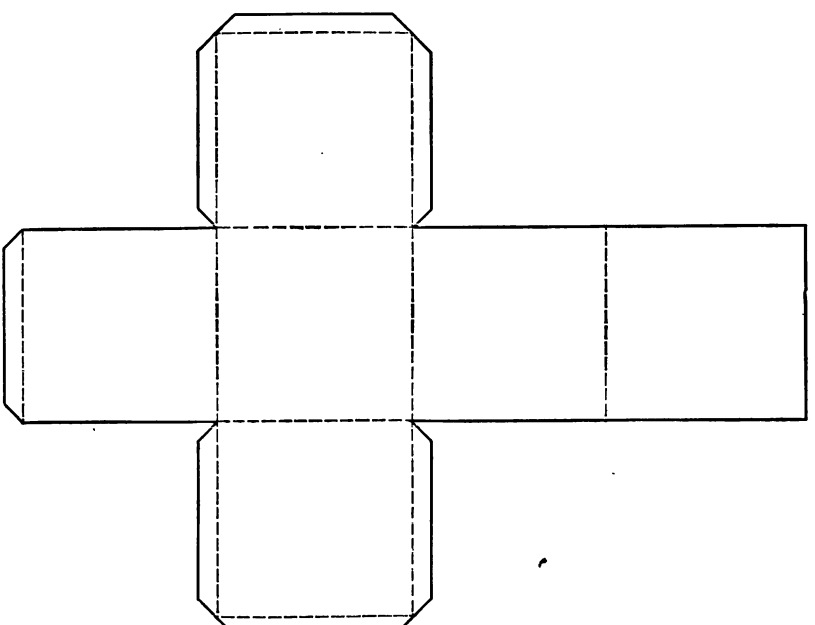
To THE TEACHER. — Cubes of various sizes should be provided for this lesson. Inch cubes should be put together to make two-inch cubes, three-inch cubes, and so on. Make prisms with the cubes, and gain from the children that each face of the prism is a rectangle; also that the volume of a rectangular prism is the product of its three dimensions.

A board one foot square and one inch thick can be used effectively. Mark it off to show that it contains 144 cubic inches. Gain from the children that a pile of 12 such boards would make a cubic foot.

Work with such exercises as are here outlined until pupils are perfectly familiar with these fundamental ideas of volume measure. Do not take for granted that children have these ideas, but test their knowledge by requiring them to *show* and *construct*.



This is a pattern of a cubic inch, or an inch cube. When drawn on paper, an inch cube may be made by cutting along the dark lines, folding along the dotted lines, and pasting the flaps over to hold the edges together.

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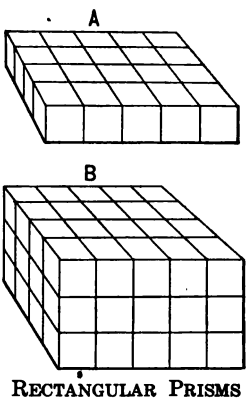
How many faces has an inch cube? What is the size of each face? Draw a pattern of a cubic inch. Cut it out and paste it together. A foot cube has how many faces? What is the size of each face? On a large sheet of stiff paper, at home, draw a pattern of a cubic foot. Bring it to school and paste it together.

Oral



RECTANGULAR PRISMS

1. Using inch cubes, make a rectangular prism 4 in. by 5 in. by 1 in. How many cubic inches does it contain? $5 \times 4 \times 1 = ?$

2. If three such prisms as figure A were piled up, they would make a prism containing how many cubic inches? $5 \times 4 \times 3 = ?$

3. How many cubic feet are there in a rectangular prism 5 ft. by 4 ft. by 3 ft.?

4. How many cubic yards are there in a rectangular prism 5 yd. by 4 yd. by 3 yd.?

5. Find the contents of a 2-inch cube. Find its entire surface.

6. A dry-goods box is 6 ft. long, 3 ft. wide, and 3 ft. deep. How many cubic feet of space will it occupy in a freight car?

7. Find the contents of a 4-inch cube. Find its entire surface.

8. A block 8 inches long, 2 inches wide, and 2 inches high will make how many 2-inch cubes?

9. From a piece of paper 8 in. square, Mabel cut enough to cover a box 2 in. by 4 in. by 1 in. How many square inches of paper were used? How many were left?

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10. How many cubic inches in a bar of soap 4 in. by 3 in. by $1\frac{1}{2}$ in.?

NOTE. — Bring bars of soap to school and measure them.

11. If a pasteboard box is 4 in. square, how high must it be to contain 32 cu. in.? $4 \times 4 \times ? = 32$ $16 \times ? = 32$

12. A block of wood is 3 in. wide and 2 in. thick. How long must it be to contain 60 cu. in.? $3 \times 2 \times ? = 60$

13. $2 \times 5 \times ? = 70$ $? \times 3 \times 4 = 48$ $7 \times ? \times 2 = 28$

14. If a cubic foot of ice weighs 60 lb., what is the weight of a cake of ice 2 ft. by 1 ft. by 1 ft.?

15. Will's lunch box is 8 in. long, 4 in. wide, and 3 in. thick. What is its volume?

16. If a common brick is 8 in. by 4 in. by 2 in., how many cubic inches does it contain? What is the area of one of its largest faces? How many such faces has it? What is the area of one of its smallest faces? How many such faces? What is the area of one of the other faces?

NOTE. — Bring a brick to the class and verify these results.

17. Find the contents of a rectangular prism 3 in. by 4 in. by $2\frac{1}{2}$ in.

18. A cubic foot is how many inches wide? high? long? It contains how many cubic inches?

19. A cubic yard is how many feet wide, high, and long? It contains how many cubic feet? Show this by a drawing.

20. How many square inches in one face of a cubic foot?

21. How many square feet in one face of a cubic yard?

22. How many cubic feet are there in a pile of wood 8 ft. by 4 ft. by 4 ft.?

23. Learn the table of Volume Measure, p. 117.

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TABLE OF VOLUME MEASURE

1728 cubic inches (cu. in.)	= 1 cubic foot (cu. ft.)
27 cubic feet	= 1 cubic yard (cu. yd.)

Written

1. How many cubic inches are there in one cubic yard?

2. (*a*) How many cubic inches are there in $5\frac{3}{8}$ cu. ft.? (*b*) In $10\frac{5}{8}$ cu. ft.? (*c*) In $25\frac{4}{9}$ cu. ft.? (*d*) In 307 cu. ft.?

3. (*a*) How many cubic feet are there in $70\frac{8}{9}$ cubic yards? (*b*) In $235\frac{1}{2}$ cubic yards? (*c*) In $\frac{2}{3}$ of a cubic yard? (*d*) In $33\frac{1}{3}$ cubic yards? (*e*) In $66\frac{2}{3}$ cubic yards?

4. 9234 cu. ft. = how many cubic yards?

5. How many cubic feet are there in 24,192 cu. in?

6. How many cubic feet in 84 cu. yd. 17 cu. ft.?

7. Change 38 cu. ft. 347 cu. in. to cubic inches.

8. A cake of ice containing $3\frac{1}{2}$ cu. ft. contains how many cubic inches?

9. How many cubic feet are there in $7\frac{2}{3}$ cu. yd.?

10. Change 13 cu. yd. to cubic feet.

11. Change 513,216 cu. in. to cubic feet.

12. A carload of earth containing 19.8 cu. yd. contains how many cubic feet?

13. $7 \times 8 \times ? = 280$. The contents of a rectangular prism are 280 cu. in. Two of its dimensions are 7 in. and 8 in. What is the other dimension?

14. The dimensions of a water tank are 10 ft., 11 ft., and $2\frac{1}{2}$ ft. What is the volume of the tank?

15. A gallon contains 231 cubic inches. Seven gallons are how many cubic inches less than one cubic foot?

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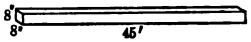
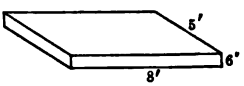
16. A pile of wood 8 ft. long, 4 ft. wide, and 4 ft. high contains how many cubic feet?

17. A stick of timber 8 in. square and 45 ft. long contains how many cubic inches? (First change 45 ft. to inches.)



18. (*a*) A block of granite 16 ft. by $3\frac{3}{4}$ ft. by $2\frac{5}{8}$ ft. contains how many cubic feet? (*b*) How many cubic inches?

19. A flagstone 8 ft. long, 5 ft. wide, and 6 in. thick contains how many cubic feet?



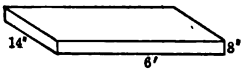
HINT: The stone is what part of a foot in thickness?

20. A street 100 rods long must be lowered 3 ft. in order that a pavement 36 ft. wide may be laid. (*a*) How many yards long is the street? (*b*) The cut is how many yards wide? (*c*) How many cubic yards must be cut out?

21. (*a*) A box car 30 ft. long, 9 ft. wide, and 7 ft. high contains how many cubic feet of space? (*b*) How many cubic yards?

22. A schoolroom is 39 ft. long, 30 ft. wide, and 12 ft. high. (*a*) How many cubic feet of air space are there in the room? (*b*) How many cubic yards? (*c*) If there are 40 pupils in the room, how many cubic feet of space are there for each pupil? (*d*) How many cubic yards are there for each pupil?

23. A concrete step is 6 ft. long, 14 in. wide, and 8 in. high. How many cubic feet of concrete does it contain? (Change 14″ and 8″ to feet.)



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MEASURING TIME

TABLE OF TIME

60 seconds (sec.)	= 1 minute (min.)
60 minutes	= 1 hour (hr.)
24 hours	= 1 day (da.)
7 days	= 1 week (wk.)
365 days	= 1 common year (yr.)
366 days	= 1 leap year

Ten years make a *decade*, and one hundred years make a *century*, but these terms are not used in arithmetical calculations.

The four thirty-day months may be remembered easily by the following old rhyme:

"Thirty days hath September,
April, June, and November."

February has 28 days, with 29 in leap year. The other months have 31 days.

Oral

1. How many minutes are there in a working day of 8 hr.?

2. A man who works for 30¢ an hour receives how much a minute?

3. A train that is running at the rate of 2 miles in 3 minutes goes how many miles in an hour? In 10 hours? In 24 hours?

4. A boy who is idle 15 minutes in every hour wastes what part of his time?

5. How many hours are there in a week? In the month of June?

6. How many hours have we for work in a morning session of school if it begins at 9 o'clock and closes at 11.45, allowing a quarter of an hour for recess?

7. How many days are there in the fall months?

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TABLE OF COUNTING

12	= 1 dozen (doz.)
12 doz.	= 1 gross
20	= 1 score

Oral

1. Name three articles that are sold by the dozen.

2. Name three articles that are sold by the gross.

3. The term *score* is not used in arithmetical calculations. We should remember that it means *twenty*, because the word occurs often in speech and in print.

"Four-score and seven years ago" was how many years ago? Do you know who used that expression, and where and when?

4. When your school board pays 60¢ a gross for pens, how much is paid per dozen?

5. How much is received for a gross of coat hooks, when they are sold at 10¢ a dozen?

6. A merchant buys screws at 20¢ a gross and sells them at 5¢ a dozen. What is his profit on 2 gross?

7. How many Seiler's tablets are there in a box containing ten gross?

8. Clothespins bought at 50¢ a gross and sold at 1¢ apiece yield what profit on a gross?

9. A gross of tennis balls will cost how much, at $3 a dozen? How much apiece would that be?

10. A case of eggs contains 30 dozen. How many gross is that?

11. How old is your grandfather if he has lived three-score and twelve years?

12. How much will a gross of oranges cost at 40 cents a dozen?

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REVIEW AND PRACTICE

Oral

1. Read 428,160,200; 1,001,010; XCVII.

2. Add 36 and 45; 73 and 27; 18 and 56; 20 and 134.

3. Subtract 32 from 85; 19 from 35; 65 from 81.

4. Multiply 26 by 10; 439 by 100; 50 by 20; 43 by 200.

5. Ella missed 5 words on Monday, 1 on Tuesday, 0 on Wednesday, 3 on Thursday, and 1 on Friday. What was the average for the week?

6. The number of hits made by the Grant School team during the nine innings of a ball game was as follows: 2, 6, 7, 5, 1, 0, 2, 0, 4. What was the average per inning?

7. How many tiles $2'' \times 4''$ will make 1 sq. ft. of hearth?

8. Give two numbers that are prime to each other.

9. $1\frac{1}{2} + \frac{3}{4} = ?$	10. $7\frac{1}{8} + \frac{1}{2} = ?$	11. $4\frac{3}{7} + \frac{4}{7} = ?$
12. $29\frac{2}{3} + 3\frac{2}{3} = ?$	13. $30 - \frac{7}{12} = ?$	14. $5 - 2\frac{9}{16} = ?$
15. $\frac{2}{3} + \frac{1}{2} = ?$	16. $\frac{1}{3} + \frac{3}{4} = ?$	17. $3\frac{3}{5} + 1\frac{1}{2} = ?$
18. $8\frac{1}{3} + 2\frac{1}{4} = ?$	19. $17 - 8\frac{7}{9} = ?$	20. $16\frac{1}{2} - 1\frac{1}{7} = ?$

21. A piece of ribbon 2 in. wide and $\frac{1}{4}$ yd. long contains how many square inches?

22. Mr. Henderson bought half a gross of screw eyes at the rate of 10¢ a dozen. What did they cost?

23. What is the cost of 48 sheets of paper at 15¢ a quire?

24. A kitchen floor $12' \times 15'$ requires how many square yards of linoleum to cover it?

25. A pane of glass covering 63 sq. in. is $\frac{3}{4}$ ft. long. How wide is it?

26. $\frac{1}{2} \times \frac{1}{3} = ?$	27. $\frac{2}{5} \times \frac{3}{8} = ?$	28. $1\frac{1}{2} \times 3\frac{1}{3} = ?$
29. $\frac{4}{7} \div \frac{1}{3} = ?$	30. $2\frac{1}{2} \div \frac{1}{4} = ?$	31. $3 \div \frac{6}{7} = ?$

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Written

Add, and test by adding another way. Practice until you can do it in 5 minutes. Add two figures at once where possible.

1.	2.	3.	4.
$23.48	865	3945	8609
5.90	792	867	4738
73.84	341	4730	889
6.95	763	5905	437
7.23	849	4321	6898
4.87	731	8765	7934
5.98	496	487	6520
8.64	783	509	8659
2.36	504	376	756

A Drill for Speed and Accuracy

23.48 — 17
5.90 — 14
73.84 — 22
6.95 — 20

Have the above numbers copied on the blackboard. Let pupils, one at a time, go to board and read (mentally) the sum of the figures in each number, from left to right, putting results down as rapidly as possible. Keep a record of the time. Add two seconds for every mistake. The entire number should be taken in at a glance and the sum put down almost instantly. This is an excellent drill for concentration. Pupils at seats copy numbers and "check" their results by the results on the blackboard.

5. A man bought a ton of meal for $43\frac{1}{4}$ and five 80-lb. sacks of bran at $1\frac{1}{4}$ per sack, mixing them for horse-feed.
   a. How many pounds of feed had he?
   b. How many hundredweight?
   c. How much did it cost?
   d. How many dollars did 1 cwt. of the mixture cost?

Add:

6.	7.	8.	9.
$248\frac{1}{8}$	$83\frac{5}{9}$	$902\frac{7}{9}$	$75\frac{2}{7}$
$396\frac{1}{4}$	$16\frac{1}{2}$	$38\frac{1}{5}$	$81\frac{1}{2}$
$29\frac{13}{16}$	$86\frac{5}{6}$	$43\frac{7}{15}$	$16\frac{1}{4}$

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10. If 6 acres of land cost \$438, how much will 42 acres cost at the same price per acre? (42 acres are how many times 6 acres?)

11. How many loads of earth can be bought for \$80 when \$400 will buy 1135 loads? (\$80 is what part of \$400?)

Subtract:

12. $83\frac{5}{8} - 72\frac{5}{16}$ **13.** $42\frac{4}{9} - 16\frac{2}{3}$ **14.** $173\frac{29}{30} - 78\frac{3}{5}$ **15.** $91\frac{1}{7} - 80\frac{2}{9}$

Find results:

16. $\frac{8}{17} \times 2\frac{1}{4}$ **17.** $\frac{3}{7} \times \frac{2}{3} \times 5\frac{1}{4}$ **18.** $1\frac{1}{2} \times 3 \times 1\frac{5}{24}$

19. $\frac{7}{9}$ is how many times $\frac{2}{21}$? $(\frac{7}{9} = ? \times \frac{2}{21})$

20. Divide $\frac{13}{15}$ of $\frac{9}{11}$ by $3\frac{3}{5}$ times $1\frac{7}{11}$.

21. Divide $\frac{3}{5}$ of $\frac{5}{7}$ of $\frac{4}{9} \times 3\frac{1}{4}$ by $\frac{5}{8}$ of $\frac{12}{25}$ of $\frac{4}{9}$.

22. \$68$\frac{5}{8}$ will buy how many barrels of flour at \$7$\frac{5}{8}$ a barrel?

23. Find the value of $\frac{5\frac{3}{4}}{6\frac{1}{2}}$.

24. The area of a wall map is $976\frac{7}{8}$ square inches. Its length is $42\frac{1}{2}$ inches. Find its width.

25. An alley between two houses is $\frac{7}{8}$ of a rod wide and $7\frac{1}{2}$ rods long. How many square rods of land does it contain?

26. How long will 16 bu. of corn last Fred's chickens if he feeds them 1 qt. a day?

27. 2 bbl. of cranberries, each containing 3 bu., are worth how much at 18¢ per quart?

28. The speed limit for automobiles in our city is 12 miles per hour. That is how many rods per minute?

29. What is the cost of 5 T. 500 lb. of coal at \$7.40 per ton?

30. $\frac{1}{4}$ T. is equal to how many ounces?

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THE "ONE HUNDRED" RECORD

Names of All Pupils in Class	Multiplication Table	Long Division	Multiplication by Three Figures	Difficult Subtraction	Reduction to Lowest Terms	Reduction of Mixed Numbers	Adding Fractions	Subtracting Fractions	Multiplying Fractions	Dividing Fractions	Factors and Products	Seeing Relations	Finding Volume	Finding Areas	Tables
Raymond Oldt	x	x			x		x								
Rose Kapfer	x	x													
Sidney Sands	x		x			x									
Sarah Archer	x			x			x								
Fred Leary	x	x	x		x				x						

Place this form on the blackboard, or on a large card hung upon the wall. Enter all names at the beginning. Permit children to come and ask for a test in any topic before or after school or at other times designated by the teacher. Check the topic as soon as a perfect test has been made.

The above record shows that Sidney Sands has made perfect tests in Multiplication Table, Multiplication by Three Figures, and Reduction of Mixed Numbers.

This plan promotes friendly rivalry, fixes responsibility upon the pupil, and encourages pupils to overcome one difficulty at a time.

When one list is completed, add other topics, or begin a new one. It is well to start with a small list.

By reference to the blank spaces, both teacher and pupil may see at a glance where the pupil's weak spots are, and where "individual" work is necessary. Always provide some very easy topics, so that the poorest scholar may make a start.

What an Account Is

Everyone should keep an exact record of the money which he receives for wages, and from all other sources. He should also keep a record of the money expended. Such a record, showing money received and money expended, is an account.

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HOW TO KEEP AN ACCOUNT

Here is a college boy's account for one week.

1918		*Receipts*			1918		*Expenditures*		
Apr.	1	*Bal. Brought for'd from March*	2	28	Apr.	2	*Carfares*		25
							Purse		75
	2	*Check from Father*	25	00			*Symphony Concert ticket*	2	00
	4	*Services for March in Library*	10	00			*Board for March*	19	00
	7	*Services with typewriter*	2	15		3	*Gym. fee*	2	00
							Student Body tax	2	00
							Laundry	2	00
						4	*Razor blades*		35
							Carfares		10
						6	*Church*		25
							Postage		10
							Balance on hand Apr. 8	10	63
			39	43				39	43

This young man earns a part of his expense money by working in the College Library and by copying themes and theses with his typewriter. At the end of every month he sends his father a copy of his account for the month. If his expenditures had been greater than his receipts, the "balance" would have been on the other side of the account, the balance being the sum necessary to be added to the smaller sum to equal the larger, or to make the two sides of the account "balance."

When one transacts business for another, or acts as treasurer for an organization, he should keep an exact account of receipts and expenditures. A book suitable for this purpose may be purchased for a few cents.

If you were the class treasurer to collect gifts for the Red Cross, should you keep an account? Would there be expenditures?

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KEEPING ACCOUNTS

Rule your paper, and make out the accounts of the following transactions, showing the balance in each case:

1. Mrs. Worthington, during the first week in July, spent $7 for groceries, 40¢ for ice, and $1.28 for vegetables and fruit. She paid a gas bill of $1.65, an electric light bill of $1.10, and a telephone bill of $2.00. She had $1.67 remaining from the previous week, received her weekly allowance of $12 for household expenses, and sold some cherries and currants for $2.15. Make out her account for household expenses for the week.

2. Mr. True superintended the repairs on Miss Gilbert's house. June 15 he paid out $12.75 for lumber, 30¢ for nails, $5.83 for plumbing, and $2.35 for screen wire. On June 20, he paid $98.75 for painting and kalsomining, $14 for carpenter work, and $2.50 for labor. On June 16 he received $10 in cash, and on June 21 a check for $50. Make out Mr. True's account.

3. Alfred took a vacation trip. He had saved $3.69; his father gave him $2.90 and his Uncle Joe gave him $1.00. He paid $.65 for fishing tackle, $2.18 for railroad fare, 50¢ for boat hire, and $3.50 for board. Make out his account, putting in dates.

4. Suppose you are treasurer of a baseball club. Make out your account, showing money received from a Saturday exhibition, from gifts, and on hand when you were elected. Show expenditures for suits, bats, and balls.

5. Suppose you are treasurer of a sewing club. Make out an account similar to the one in 4.

6. Suppose you are treasurer of your class when it holds an ice-cream and candy sale to raise money for a picture. Let the class suggest items to be entered as receipts and as expenditures. Make out your account.

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HOW TO ATTACK A PROBLEM

1. Most of us can solve a problem easily when it requires only one process, such as addition, subtraction, multiplication, or division. Sometimes, even then, we are in doubt between addition and subtraction, or between multiplication and division.

Where only one process, or step, is required we are usually given two facts from which to find a third, which is the answer. For example, Frank earned 75¢ a day. He worked 5 days. These are the two facts that are given. From them we may find a third fact. What is it?

2. When more than one step is required, we may have two facts given, but we cannot obtain the answer until we find another fact and use that to find the answer. For example, we may be asked to find the number of tons in two loads of coal weighing 5321 lb. and 4679 lb. We cannot find the answer by one operation. If we were given the number of tons in each load, instead of the number of pounds, we could add them to find the whole number of tons; or, if we were given the whole number of pounds, we could remember that there are 2000 lb. in a ton and then get the answer by one operation. So we may do either of two things to obtain another fact that we need, to get the answer. Which will be easier? Try it.

Sometimes it will help us decide what to do if we think, "Will the answer be greater or less than the number given?" or, "What must I find before I can use one of the given facts to get the answer?"

3. Sugar is 8¢ a pound. Louis bought 10 lb. Question.

4. A pane of glass is 16 inches long. What other fact must we have before we can find its area?

5. Dan paid $2.25 for some stockings. What other fact must we have in order to find the number of pairs he bought?

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6. Fred worked last Saturday for 10¢ an hour. What other fact must we have in order to find how much he earned?

7. A concrete column is 18 ft. high, and its other dimensions are 2 ft. by 3 ft. What must I find before I can compute the number of cubic yards it contains?

8. Three girls made bandages for the Red Cross. The first made 45 bandages, and the second made 61 bandages. What must we know before we can find how many bandages were made by the three girls?

9. Ruby's brother earns $80 a month. He spends $48.35 a month. We are to find what he saves in two years. What must we find first? In how many ways may we solve this problem?

10. Edgar went to the store with a $5 note. He bought potatoes, flour, a broom, some cans of corn. What more must we know in order to find what change he should receive?

11. A concrete sidewalk is 200 ft. long. What else must we know in order to find its area? What other fact must we still have before we can find its cost?

12. A floor contains 240 sq. ft. This and what other number would enable you to find its length? The area and what other number would enable you to find its width?

13. A soldier receives $25 a month. What else must you know in order to find what he has received since he entered the army?

14. We know the cost of 15 pounds of sugar. How may we find the cost of 30 pounds? Of 45 pounds? Of 3 pounds? Of 5 pounds?

15. A number of girls shared equally the cost of a picnic lunch, consisting of fruit, jelly, cake, sandwiches and lemonade. How shall we find each girl's part of the expense?

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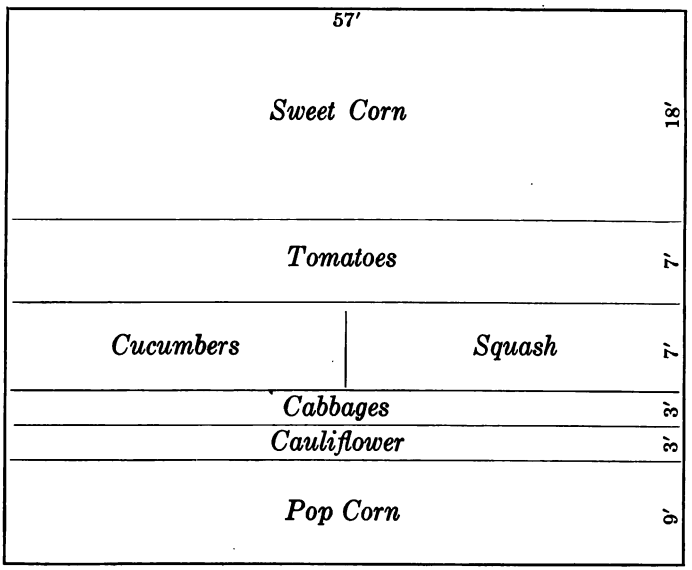
GARDEN PROBLEMS



This is the plan of a real garden which Joseph and his father cultivated. All the statements in the exercises are facts.

Take your rule and find out the scale of the plan.

1. The corn was planted so that each hill occupied one square yard of ground.

a. How many hills of pop corn were there?

b. How many hills of sweet corn?

2. There were six hills of cucumbers, and the same number of hills of squash. How many square feet of land did each hill occupy?

3. There were 15 tomato plants. How much space did each plant have?

4. The cabbage and cauliflower plants each had $7\frac{1}{8}$ square feet of space. How many plants were there?

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5. The family table was supplied with vegetables from the garden, a correct account of them being kept. Those not needed at home were sold by Joseph during his spare time, mornings and Saturdays.

Find the value of each of the following productions:

a.	Sweet corn	312 ears	25¢ per doz.
b.	Tomatoes	300 lb.	3¢ per lb.
c.	Pop corn	54 lb.	6½¢ per lb.
d.	Cucumbers	219	3 for 10 cents
e.	Squash	88 lb.	3½¢ per lb.
f.	Cauliflower	20 heads	18¢ apiece
g.	Cabbage	22 heads	9¢ apiece

6. The first ripe tomatoes were gathered on the 14th day of August and the latest on the 17th day of October. How many days did they last?

7. A crop of peas was grown before the cabbage and cauliflower plants were set out. Peas were raised, also, on either side of the rows of tomatoes, cucumbers, and squash before those vines began to spread. The crop of peas was $2\frac{1}{2}$ bu. and they were worth 45¢ a peck. Find the value of the crop of peas raised here.

8. Beans were planted between the rows of corn and matured before the corn was high enough to shut out the sun. The three bushels of string beans thus raised were worth how much at 9¢ a quart?

9. Draw a plan of your home garden, showing the space given to each vegetable. If you have no garden, draw a plan of the garden you would like to have, or one that you have seen.

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PROBLEMS OF THRIFT

Oral

1. Elwin rides to school every morning and home at night, using each time a half fare ticket costing $2\frac{1}{2}$ cents. Sam, who lives next door to Elwin, walks every time and puts the carfare in his bank. Allowing 200 school days for a year, how much will Sam save in a year? If he makes this saving for ten years, how much will it amount to? If the bank pays 4% simple interest, this money will earn $20 interest. Sam, by walking to school, will have saved how much toward his college course?

2. Sam saves $50 each summer for 4 summers while in the high school. How much will that help toward his college course?

3. Sam helps a grocer every Saturday for $1. How much will this amount to in five years?

4. Frank lives on a farm and makes $50 every year from the acre of choice land that his father allows him to use. How much will he make in six years?

5. A woman who lives near the grocery takes her lamp to the grocery to be filled and pays 5 cents every time. The lamp holds a pint of oil.

a. How much per gallon does the oil cost her?

b. If the lamp burns one pint of oil in two days, in how many days will it consume one gallon of oil?

c. In how many days will it consume four gallons?

d. How much would she save by buying four gallons of oil at $12\frac{1}{2}$¢ a gallon?

6. Elsie, Nina, and Robert gathered 2 bu. of chestnuts and sold them for 20¢ a quart. How much did they receive?

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ALIQUOT PARTS

$\frac{1}{2}$ of \$1.00 = 50¢	$\frac{1}{8}$ of \$1 =
$\frac{1}{3}$ of \$1.00 = $33\frac{1}{3}$¢	$\frac{1}{10}$ of \$1 =
$\frac{1}{4}$ of \$1.00 =	$\frac{1}{12}$ of \$1 =
$\frac{1}{5}$ of \$1.00 =	$\frac{1}{16}$ of \$1 =
$\frac{1}{6}$ of \$1.00 =	$\frac{1}{20}$ of \$1 =
$\frac{1}{7}$ of \$1.00 =	$\frac{1}{25}$ of \$1 =

Complete the above table.

Observe that in each case you find *one* of the *equal* parts of \$1.

The numbers of cents which you have found are **aliquot parts** of \$1, because each of them is *one of the equal parts* of a dollar.

Fifteen days is one of the aliquot parts of a 30-day month because it is one of the equal parts of a 30-day month.

Name three other aliquot parts of a 30-day month.

Why is 30¢ not an aliquot part of \$1?

Why is 12 da. not an aliquot part of a 30-day month?

Six months is an aliquot part of a year. Why?

Three months is an aliquot part of a year. Why?

Two months is an aliquot part of a year. Why?

Eight months is not an aliquot part of a year. Why?

Four ounces and eight ounces are aliquot parts of a pound. Why?

Twelve ounces is not an aliquot part of a pound. Why?

> *One of the equal parts of a number* is an **aliquot part** of that number.

Sometimes the use of aliquot parts shortens the solution of a problem. For example, when peaches are 25¢ per dozen, eight dozen will cost $8 \times \$\frac{1}{4}$ or \$2.00.

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These are other convenient fractions of 100:

$\frac{3}{8}$ of 100 = $37\frac{1}{2}$	$\frac{2}{3}$ of 100 = ?
$\frac{5}{8}$ of 100 = $62\frac{1}{2}$	$\frac{3}{4}$ of 100 = ?
$\frac{7}{8}$ of 100 = ?	$\frac{4}{5}$ of 100 = ?

Oral

(This is for class work, not for study assignment.)

1. At 25¢ each, what will 8 handkerchiefs cost? How many can be bought for \$3? (How many for \$1?)

2. When cloth is 20¢ a yard, how many yards will \$15 buy? (\$15 ÷ $\$\frac{1}{5}$ = ?)

Multiply:

3. $12\frac{1}{2}$ cents by 16
4. $16\frac{2}{3}$ cents by 12
5. 25 cents by 20
6. $33\frac{1}{3}$ cents by 27
7. $6\frac{1}{4}$ cents by 16
8. $8\frac{1}{3}$ cents by 24
9. $37\frac{1}{2}$ cents by 8
10. 50 cents by 15
11. $62\frac{1}{2}$ cents by 8
12. $66\frac{2}{3}$ cents by 9
13. 75 cents by 4
14. $87\frac{1}{2}$ cents by 8

What is the cost of:

15. 16 pounds of bacon at 25¢ a pound?
16. 16 balls at 50¢ each?
17. 36 yards of ribbon at $33\frac{1}{3}$¢ a yard?
18. 36 pounds of candy at 25¢ a pound?
19. 8 pounds of tea at $62\frac{1}{2}$¢ a pound?
20. When 4 geographies cost \$3, what is the cost of one? Of 9? Of 11? Of 15? (There is an easier way to find the cost of 20 geographies. What is that way?)
21. At \$.75 apiece, what must be paid for 3 chairs? 4 chairs? 6 chairs? 16 chairs? 40 chairs?

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22. At 25¢ per pound, how many pounds of cheese can be bought for \$45? (\$45 ÷ \$$\frac{1}{4}$ = 45 × 4 = ?)

Divide:

23. \$3 by 33$\frac{1}{3}$¢	**24.** \$9 by 12$\frac{1}{2}$¢	**25.** \$6 by 33$\frac{1}{3}$¢
26. \$5 by 25¢	**27.** \$1 by 6$\frac{1}{4}$¢	**28.** \$4 by 12$\frac{1}{2}$¢
29. \$2 by 8$\frac{1}{3}$¢	**30.** \$10 by 50¢	**31.** \$2 by 25¢

32. \$3 divided by 8$\frac{1}{3}$¢ = ? (3 ÷ $\frac{1}{12}$ = ?)

33. At 25 cents apiece, how many hats can be bought for \$6?

34. At 25 cents a pound, how many pounds of cheese can be bought for \$5? (How many pounds for \$1?)

35. At 16$\frac{2}{3}$ cents a dozen, how many dozen eggs can be bought for \$4?

Written

What is the cost of:

1. 166 pounds of pork at 12$\frac{1}{2}$ cents a pound?

2. 348 pounds of veal at 16$\frac{2}{3}$ cents a pound?

3. 265 boxes of strawberries at 25 cents a box?

4. 1215 yards of flannel at 33$\frac{1}{3}$ cents a yard?

5. 3580 pounds of honey at 20 cents a pound?

6. 748 pounds of tea at 50 cents a pound?

7. What is the value of 728 sacks of potatoes at 87$\frac{1}{2}$¢ a sack? (87$\frac{1}{2}$¢ is what part of a dollar?)

8. What must the school board pay for 960 gross of pens at 62$\frac{1}{2}$¢ per gross?

9. What did Mr. Stone, the druggist, pay for 584 boxes of candy at an average price of 37$\frac{1}{2}$¢ per box?

10. At 25¢ per box, how many boxes of candy could be bought for \$89? (How many boxes for \$1?)

11. Fred saves 75¢ a week. In how many weeks will he save \$37$\frac{1}{2}$?

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REVIEW AND PRACTICE

(For class exercise, not for assignment.)

Oral

1. \$8 will buy how many pounds of butter at 25¢ a pound?

2. At $33\frac{1}{3}$¢ a bushel, \$3 will pay for how many bushels of turnips?

3. \$1 is the cost of how much cheesecloth at $6\frac{1}{4}$¢ a yard?

4. Find the cost of 24 yd. of ribbon at $8\frac{1}{3}$¢ a yard.

5. When \$4 will buy 24 lb. of beefsteak, how many pounds will \$1 buy? (\$1 is what part of \$4?)

6. When \$9 will pay for 72 cans of peas, what is the price per can? (How many cans for a dollar?)

7. Frank began at Chapter XVII in his book this morning and has read 12 chapters to-day. Express in Roman numerals the number of the last chapter which he read.

8. Find the cost of 300 yd. of flannel at $33\frac{1}{3}$¢ a yard.

9. *Give the products:*

$\frac{3}{4} \times 2$; $\frac{1}{2} \times 3$; $2 \times 1\frac{1}{2}$; $\frac{2}{3} \times 3$; $\frac{1}{2} \times \frac{1}{2}$; $\frac{1}{5} \times \frac{2}{3}$; $\frac{7}{8} \times \frac{1}{2}$; $\frac{1}{4} \times \frac{3}{4}$

10. 2 qt. of beans at $7\frac{1}{2}$¢ and 3 lb. of maple sugar at $8\frac{1}{3}$¢ cost how much?

11. How many one-ounce samples can be made from $2\frac{1}{2}$ lb. of cereal?

12. How many yards are there in 4 rd.?

13. What is the area of a floor 12 ft. by $6\frac{1}{2}$ ft.?

14. Express $\frac{22}{8}$ in simplest form.

15. $\frac{1}{2}$ of $\frac{1}{4}$ of a gallon is how many gills?

16. When 3 cents will buy $\frac{1}{4}$ lb. of maple sugar, what is the cost of 2 lb.?

17. $\frac{2}{5}$ of 75 ft. are how many yards?

18. $\frac{1}{3}$ of $\frac{1}{4}$ of a yard is how many inches?

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19. Margaret's mother buys $\frac{1}{2}$ lb. of sliced bacon twice a week at 30¢ per pound.

a. How much does she pay each time?

b. How much does she pay for bacon in six weeks?

c. How much would a 6-pound piece of bacon cost at 20¢ a pound?

d. How much would Margaret's mother save by buying such a piece at that price?

20. Name three sums of money that may be used conveniently in computation as fractions of $1.

Written

1. Express in figures eight hundred million eighty thousand eight.

2. Divide the product of 36, 45, 20, and 14 by the product of 80, 27, 35, and 72. (Use cancellation.)

3. Find the quotient of $27 \times 28 \times 30$ divided by $18 \times 35 \times 36$. (Use cancellation.)

4. Change $\frac{7\,8\,6}{8\,7}$ to simplest form.

5. How many ninths are there in 18?

6. Change $2\frac{1}{11}$ to 33ds.

7. $8\frac{1}{7} - 2\frac{1\,6}{2\,1} + 3\frac{5}{1\,4} = ?$

8. A man bought $5\frac{7}{1\,2}$ acres, $6\frac{7}{2\,4}$ acres, and $10\frac{1}{4}$ acres of land. He then gave his son $11\frac{7}{8}$ acres. How many acres had he left?

9. The sum of two fractions is $\frac{14}{15}$. One of them is $\frac{3}{10}$. What is the other?

10. The product of two fractions is $\frac{3}{10}$. One of them is $\frac{14}{15}$. What is the other?

11. Find the cost, at $.62\frac{1}{2}$ a bushel, of the seed oats for a field of $7\frac{1}{5}$ acres, if the farmer sows 2 bu. on an acre.

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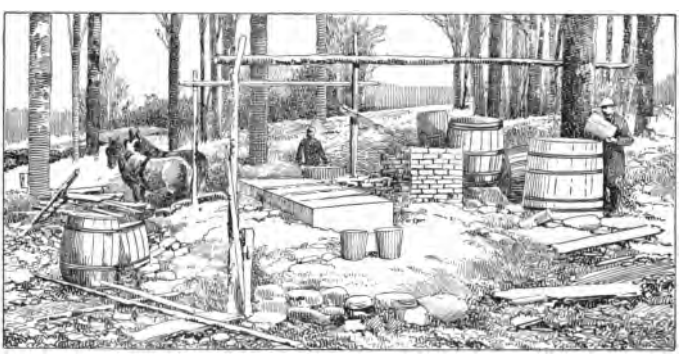
12. Draw a plan of a rectangular lawn 4 rd. by 2 rd., using $\frac{1}{16}$ of an inch for a foot. That is, draw it to the scale of $\frac{1}{16}''$ to 1′.

13. Find the cost of $325\frac{4}{5}$ bu. of wheat at $\$1.66\frac{2}{3}$ per bushel. (Express $\$.66\frac{2}{3}$ as a fraction of a dollar.)

14. How long will it take a motor car to travel $87\frac{5}{8}$ mi., if it travels at the rate of $12\frac{3}{8}$ mi. in half an hour?

15. Make a problem about 7 tons of coal, $43.75, and 28 tons of coal. Find the answer.



16. In a Vermont sugar orchard there were 368 trees. The average "run" of sap for one week was 24 qt. per tree. (*a*) How many gallons of sap were there to be gathered that week? (*b*) It yielded one pound of sugar to three gallons of sap. How many pounds of sugar did it make? (*c*) The cask in which the sap was drawn to the boiling camp holds two barrels of sap. How many times was it filled, allowing 12-qt. waste?

17. One year is $365\frac{1}{4}$ days. How many days are there in 29 years?

18. A dairyman sent 237 quarts of milk to the creamery. If the milk weighed $2\frac{3}{16}$ pounds per quart, what was the total weight?

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EXERCISES FOR CLASS DRILL

(Not for assignment.)

Practice until you can get all sums correct in four minutes.

1.	2.	3.	4.
437	8634	$83.94	1111
598	7951	9.16	888
643	3718	8.27	222
287	4216	5.83	6374
965	7954	28.64	908
309	3156	7.95	99
780	7832	4.03	27
593	3078	83.00	356
768	9239	7.19	832

For rapidity and accuracy, add digits from left to right as directed on page 6. Divide class into teams of 4, and try for a record.

Subtract, and test by addition:

5.	6.	7.	8.
$48\frac{5}{7}$	$935\frac{1}{8}$	$83\frac{3}{7}$	$820\frac{3}{16}$
$29\frac{2}{3}$	$648\frac{5}{16}$	$46\frac{5}{9}$	$420\frac{5}{6}$

Find the factor not given; in some of these exercises it will be a mixed number. Test by multiplication.

	Given Factor	Given Product				
		A	*B*	*C*	*D*	*E*
9	89	42,898	27,323	62,839	35,511	27,412
10	429	52,767	138,014	184,041	193,428	136,422
11	438	30,622	523,429	33,288	79,435	191,844
12	902	39,517	813,604	44,600	168,007	23,871
13	503	159,954	59,132	318,641	231,428	104,624
14	8900	560,700	7,137,800	801,000	890,000	596,300

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PROBLEMS WITHOUT NUMBERS

1. Claude's spelling mark for Monday was ——, for Tuesday ——, for Wednesday ——, for Thursday ——, and for Friday ——. What was Claude's average for the week?

(*Ans.* Claude's average was the sum of the five daily marks divided by 5.)

2. What is the average age of the pupils in your class?

3. Henry worked —— days, for —— hours each day, at —— cents per hour. How much did he earn?

4. The product of two numbers is ——. One of the numbers is ——. What is the other number?

5. A window pane in my room is —— inches long, and contains —— square inches of glass. How wide is it?

6. Isabel made a box for Christmas candy. It was —— inches long, —— inches wide, and —— inches deep. It contained how many cubic inches?

7. Our coal bin is —— feet long, —— feet deep, and —— feet wide. It will hold how many cubic feet of coal?

8. The sides of a house are —— ft., —— ft., —— ft., and —— ft. What is its perimeter?

9. The length and breadth of a field are —— rods and —— rods. How many acres does it contain?

10. Mr. Jordan's cornfield was —— rd. long and —— rd. wide. It yielded 63 bu. per acre. How many bushels of corn did Mr. Jordan have?

11. Mr. Phillips sowed —— bu. of wheat per acre, and harvested —— bu. per acre. How much was his increase on —— acres?

12. Our train was —— hr. and —— min. late. How many minutes late was it?

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REVIEW OF PRINCIPLES AND PROCESSES

1. A fraction always indicates what operation?

2. What is cancellation?

3. Cancellation shortens what processes?

4. When the factors of a number are known, how may the number be found?

5. When a number and one of its two factors are known, how may the other factor be found?

6. How may an improper fraction be changed to a whole or mixed number?

7. How may yards be changed to inches?

8. How may fractions be multiplied?

9. When the dimensions of a rectangle are known, how may its area be found?

10. When the area and one dimension of a rectangle are known, how may the other dimension be found?

11. A solid has how many dimensions?

12. When the three dimensions of a rectangular prism are known, how may its volume be found?

13. When the volume and two dimensions of a rectangular prism are known, how may the other dimension be found?

14. When one dimension of a rectangle is given in inches and the other in feet, what must be done in order to find the area in square inches? In square feet?

15. When one dimension of a rectangular prism is given in inches, another in feet, and another in yards, what must we do in order to find the volume in cubic inches? In cubic feet? In cubic yards?

16. Name five sums of money that are aliquot parts of $1.

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Quick Mental Test (10 minutes)

1. $\frac{1}{2}$ gross are how many dozen?
2. 9 cu. ft. are what part of a cubic yard?
3. A cake of ice 2′ by $1\frac{1}{2}$′ by 1′ contains how many cubic feet?
4. How many square inches of paper are there in a sheet 6 inches long and $4\frac{1}{2}$ inches wide?
5. A piece of wire screen is 2 ft. wide. How long must it be to contain 15 sq. ft.?
6. A piece of carpet 25 ft. long contains how many yards?
7. 12 ounces are what part of a pound?
8. 3 pints are how many quarts?
9. When 3 lb. of sugar cost 20¢, what will 9 lb. cost?
10. Three fish weigh 10, 12, and 8 ounces. What is their average weight?

Short Written Tests

I. 1. *Add* $247\frac{3}{8}$ and $542\frac{4}{5}$

2. *Subtract* $29\frac{3}{4}$ from $68\frac{7}{9}$

3. $\frac{4}{5} \times 8 \times 7\frac{1}{2} \times \frac{15}{16} = ?$

4. $37\frac{1}{2} \div 16\frac{3}{5} = ?$

II. *Find:*

1. The cost of 500 lb. of coal at $6.72 a ton.
2. The number whose factors are $35\frac{3}{3}$ and $22\frac{1}{8}$.
3. Tom's weekly wages when he earns $\$17\frac{7}{8}$ in $3\frac{1}{4}$ weeks.
4. The width of a 6-acre field that is 48 rods long.

III. *Find the answers and test them in —— minutes:*

1. 358×244
2. $87{,}654 - 79{,}558$
3. $793 + 429 + 387 + 605 + 803 + 786$
4. $8\frac{3}{4} \div 9\frac{2}{5}$

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SIXTH GRADE

FIRST HALF

DECIMALS

NOTE. — Classes beginning the 6th grade work will do well to review the last six pages of the 5th grade course.

In the study of integers, we have learned that the value of a figure depends upon its place in a number, that each removal of a figure one place to the left increases its value tenfold, and that each removal of a figure one place to the right diminishes its value tenfold.

We have used this principle thus far in dealing with integers only; but it holds true also for numbers smaller than one. Thus,

Moving 5 to the right

500.
50. = (500. ÷ 10)
5. = (50. ÷ 10)
.5 = (5. ÷ 10 or $\frac{5}{10}$)
.05 = (.5 ÷ 10 or $\frac{5}{100}$)
.005 = (.05 ÷ 10 or $\frac{5}{1000}$)

Moving all the figures to the right

734. = (7340. ÷ 10)
73.4 = (734. ÷ 10 or $73\frac{4}{10}$)
7.34 = (73.4 ÷ 10 or $7\frac{34}{100}$)
.734 = (7.34 ÷ 10 or $\frac{734}{1000}$)

Notice that we place the decimal point (.) at the right of units' place. This shows where the integer ends and the fraction begins.

Observe,

That .05 = 5 ÷ 100.
That .005 = 5 ÷ 1000, etc.

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READING AND WRITING DECIMALS

The places at the right of the decimal point are called **decimal places** *and are named much like those at the left,* thus:

Thousands	Hundreds	Tens	Units		Tenths	Hundredths	Thousandths	Ten-thousandths	
									Etc.
4	6	3	8	.	7	5	4	9	

.7 is read *7 tenths.*
.75 is read *75 hundredths.*
.754 is read *754 thousandths.*
.7549 is read *7549 ten thousandths.*

1. Read .8; .49; .786; .4923.

2. Read 500; 50; 5; .5; .05; .005; .0005.

3. Read .25; .36; .39; .47; .365; .3; .7; .403; .07; .009.

4. How many cents make one dollar? What part of a dollar is one cent? 7 cents? 19 cents? 41 cents? 97 cents?

5. We write 25 cents, $.25, because it is 25 hundredths of a dollar. One dime is 1 tenth of a dollar. How would you write it? Write 5 dimes; 7 dimes.

6. 4321.648 is read 4321 *and* 648 *thousandths.*

Notice that *and* is used between the integer and the fraction.

Read: 6.42; 17.5; 4.23; 583.97; .640; 7.640; 439.018; 9341.215; 68.43; 70.9; 893.047; 903.03; 642.008; 95.249.

Read: 3.4; .0034; .987; 2048.017; .00315; 200.02.

Write in words on the blackboard: 35.08; 6.5; .084; .6082; 235.235; 64.105; 308.02; 56.081; 30.130.

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DECIMALS

$2 \times 2 = 4$ $\qquad$ $3 \times 3 \times 3 = 27$

$2 \times 2 \times 2 = 8$ $\qquad$ $10 \times 10 = 100$

Since 4, 8, 27, and 100 are obtained by multiplication, what are they called?

How do the factors of 4 compare with each other? Of 8? Of 27? Of 100?

The product of equal factors is a **power.**

Name the powers given above.

Name two other powers of 2.

Name two other powers of 10.

A fraction whose denominator is 10 *or a power of* 10 is a **decimal fraction**; *e.g.* $\frac{6}{10}$, $\frac{59}{1000}$, .25, .3421.

Only decimal fractions can be expressed by use of the decimal point as in the last exercise. When a decimal fraction is thus expressed, how may we tell what the denominator is? Name some decimal fractions not given here.

A number that is composed of an integer and a decimal fraction is called a **mixed decimal**; *e.g.* 2.5; 130.35; 21.007.

A fraction that is expressed by writing the numerator above and the denominator below a line is a **common fraction**; *e.g.* $\frac{2}{3}$, $\frac{5}{8}$, $\frac{7}{5}$, $\frac{13}{16}$, $\frac{8}{10}$.

Change to the decimal form:

1. $\frac{25}{100}$
2. $\frac{85}{100}$
3. $\frac{326}{1000}$
4. $\frac{6}{10}$
5. $\frac{16}{100}$
6. $\frac{384}{1000}$
7. $\frac{49}{100}$
8. $\frac{5}{10}$

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9. $\frac{8}{100}$	13. $\frac{9}{100}$	17. $\frac{1}{10}$
10. $\frac{15}{1000}$	14. $\frac{500}{1000}$	18. $5\frac{40}{100}$
11. $\frac{25}{1000}$	15. $\frac{50}{100}$	19. $8\frac{2}{10}$
12. $\frac{11}{100}$	16. $\frac{9}{10}$	20. $64\frac{683}{1000}$

Change to common fractions and read:

21. .36	26. .485	31. 5.6
22. .7	27. .016	32. 5.06
23. .125	28. .16	33. 5.006
24. 12.2	29. .06	34. 5.600
25. 6.25	30. .6	35. 5.060

Write, first as common fractions, or mixed numbers, then as decimals:

36. Four tenths.
37. Seventy-five hundredths.
38. One hundred twenty-five thousandths.
39. Sixteen, and forty-eight hundredths.
40. Twelve, and four tenths.
41. Six tenths.
42. Six hundredths.
43. Six thousandths.
44. How many decimal figures are required to express thousandths? Hundredths? Tenths?
45. Read the numerators only in examples 36 to 43.

Write the following as decimals, and read the numerator and denominator of each:

46. Two hundred eighty-two thousandths.
47. Fifty-six hundredths.
48. Seven tenths.
49. Five hundred eight thousandths.
50. Six hundred thousandths.

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Reading Decimals

1. What part of 10 units is 1 unit?

2. What part of 1 ten is 1 unit?

3. What part of 2 hundreds is 2 tens?

4. In the number 555, what is the value of the first 5 at the right? The second 5? The third 5?

5. Upon what does the value of any figure depend?

6. In the number 555, the value of the first 5 is what part of the value of the second 5?

7. $\frac{2}{10}$ is what part of 2 units?

8. In the number 5.5, the value of the right-hand 5 is what part of the value of the left-hand 5?

9. In the decimal .555, what is the value of the first 5 at the right? The second 5? The third 5?

10. Name the denominator of .6; .17; .105; .006; .05; .225; .3478; .06; .049; .207; .3007.

11. Read the numbers in question 10.

12. *Read:*

a. .368	*j.* 37.005	*s.* $.42\frac{1}{2}$
b. .894	*k.* 25.2036	*t.* $.69\frac{1}{6}$
c. .5328	*l.* 38.000006	*u.* $.8\frac{1}{3}$
d. .2053	*m.* .498369	*v.* $.637\frac{3}{4}$
e. 25.623	*n.* 4.9836	*w.* $.4378\frac{1}{8}$
f. 7.0063	*o.* 49.836	*x.* $.809\frac{7}{11}$
g. 28.3005	*p.* 498.36	*y.* $.430\frac{7}{10}$
h. .28962	*q.* .000400	*z.* $.6842\frac{1}{3}$
i. 15.605	*r.* .0004	

13. Tell the value of each figure in *a*; in *e*; in *g*.

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Writing Decimals

Write decimally:

1. Eight tenths.
2. 29 hundredths.
3. Six, and 284 thousandths.
4. 4584 ten-thousandths.
5. Twenty-five hundredths.
6. Twenty-five thousandths.
7. Twenty-five ten-thousandths.
8. Twenty-five hundred-thousandths.
9. Twenty-five millionths.
10. 1650, and 464 thousandths.
11. One thousand one, and 36 hundred-thousandths.
12. Sixteen, and six thousandths.
13. Seven hundred eighty-four millionths.
14. Twelve hundred-thousandths.
15. Seventy-five ten-thousandths.
16. Seven hundred five thousandths.
17. Seven hundred, and five thousandths.
18. Four thousand three ten-thousandths.
19. Four thousand, and three ten-thousandths.
20. Twenty-four, and five hundred-thousandths.
21. Seventy-one, and seven hundred-thousandths.
22. Four hundred thirty-five, and four thousandths.
23. Eight thousand three hundred forty-one ten-thousandths.
24. Ninety-nine, and eighty-six thousandths.
25. Seventy-eight, and four thousandths.
26. Nine thousand seven, and two hundred seven ten-thousandths.
27. One, and one hundred thousandths.

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ADDITION AND SUBTRACTION OF DECIMALS

We add and subtract decimals as we add and subtract whole numbers, taking care to write them so that the decimal points are all in a column, thus:

4.375	391.42
.35	165.70316
28.3065	225.71684 *Difference*
351.294	
384.3255 *Sum*	

The vacant places in the addends and in the minuend are treated as if they were occupied by ciphers.

Add:

1.	2.	3.	4.
2.2	3.25	4.5	.004
34.5	7.163	.168	4.1
79.89	15.0032	2.12	16.1563

5. .175 + 1.75 + 17.5 + 175
6. 145 + 14.5 + 1.45 + .145 + .0145
7. 3.2 + 14.0063 + .006 + 25.384 + .1
8. .8 + .446 + 59.3 + 2.575 + 1.0056 + .3
9. 1.45 + 2.365 + 96 + .96 + 15.863 + 4.3 + .0004
10. 446 + 44.6 + 37562 + 9 + .8 + .321 + .16
11. 21.0005 + .3842 + .1 + .005 + 3.6 + .158
12. 1.0006 + 2001.1 + .003 + 5.5 + 11.1111
13. 205.07 + 301.2 + 687.9124 + 83.045 + 200
14. .308 + 308. + 8.09 + 9.0786 + 859
15. 2378. + 23.50 + .890 + .089 + 1.0886

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1. *Subtract:*

a.	*b.*	*c.*	*d.*
24.3	2.86	4.	2.46
4.5	1.325	1.15	.005

2. 7 − .15
3. 1 − .004
4. 13 − 2.1
5. 3.256 − 1.05
6. 256.1 − 1.256
7. 29.325 − 15.14
8. 3.852 − .125
9. 1.1111 − .0011
10. 500 − .05
11. 25.3894 − 15.005

12. From twenty-eight, and twenty-five thousandths take fourteen, and twenty-five hundredths.

13. From one tenth take one thousandth.

14. (*a*) Which is the greater, fifty thousandths or five hundredths? (*b*) Three tenths or three hundred thousandths? (Write the numbers before answering.)

15. Take one thousandth from one thousand.

16. From five hundred take five hundredths.

Find results:

1. 175 − 30,23
2. .015 + 1.05 + .57 + 5.7 + 1.04 + .0045 + 75.36
3. 50.4 − .504
4. 25.006 + 200.00008 + 6.00005 + 49.005 + 300.059
5. 2.005 + 5.5 + 25.010 − 3.2045

6. Find the sum of two hundred forty, and four hundred fifty thousandths; thirty-four, and three hundredths; six hundred four, and six hundred four ten-thousandths; fifty, and five tenths.

7. A boy had two balls of kite string. One contained 441.3 ft. and the other 251.7 ft. He made a kite string 600.2 ft. long. How much string had he left?

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8. *Subtract:*

a. 32.854	*c.* 86.2	*e.* 21.101
9.378	43.948	7.999
b. 19.042	*d.* 36.015	*f.* 28.78
16.854	24.008	21.987

9. There are four villages on the same road. From the first to the second is 8.46 miles; from the second to the third, 10.5 miles; from the first to the fourth, 25 miles. Make a picture of the road and find the distance from the third to the fourth village.

MULTIPLYING AND DIVIDING BY MULTIPLES OF TEN

Oral

1. How may decimals be multiplied by 10? By 100? By 1000?

2. *Multiply by* 10:

5.25; .06; 3.7; 593.207; 6.800; 9.16; 82; 420; .035; .0061.

3. *Multiply by* 100:

61.843; 3.215; 75.16; 3.18; .65; 2.3; 5; 520.

4. Multiply .0612 by 10; by 100; by 1000.

5. By what must .0503 be multiplied to obtain .503? 503.? 50.3?

6. Moving the decimal point one place to the left is the same as moving all the figures of the number one place to the right. For example, by moving the decimal point one place to the left in the number 42.3, it becomes 4.23. How does this affect the value of the number?

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7. What, then, is the easiest way to divide a decimal by 10?

8. *Divide by* 10:

35.; 247.; 385.; 16.; 24.3; 2.59; 347.69; 8.137; 42.69; 394.68; .725; .042.

9. How may we divide decimals by 100? By 1000? By 10,000?

10. *Divide by* 100:

3567.8; 937.; 635.25; 42304.; 687.96; 485.03.

11. *Divide by* 1000:

986; 5321; 63,485; 983.7; 4284.25.

12. *Divide by* 10,000:

389,076; 42,831; 68,379.5; 425.

13. By what must 8193 be divided to obtain 819.3? 8.193? 81.93? .8193?

14. How must the decimal point be moved to change tenths to hundredths? Thousandths to tenths? Thousandths to millionths?

15. *Divide as follows:*

64.2 by 10; 83.75 by 10; 63.59 by 100; 4251 by 10,000; 33 by 1000; 5 by 100.

16. What is the effect of moving the decimal point three places to the left? One place? Two places? Four places?

17. *Find results:*

3.5×10; $6.5 \div 10$; $83 \div 1000$; $.987 \div 10{,}000$; $.8432 \times 100{,}000$.

18. What is the effect of moving the decimal point to the left one place? To the right two places? To the left four places? To the right six places?

19. How may we multiply a decimal by 10,000? How may we divide a decimal by 1000?

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MULTIPLICATION OF DECIMALS

Multiply 6.41 by 3.2.

$$6.41 = 641 \div 100$$
$$3.2 = 32 \div 10$$
$$6.41 \times 3.2 = 641 \times 32 \div 100 \div 10$$

641	6.41
32	3.2
1282	1282
1923	1923
20512 $= 641 \times 32$	20.512 $= 641 \times 32 \div 100 \div 10$

How did we divide by 100 and by 10?

To multiply decimals we multiply the factors as whole numbers and point off in the product as many decimal places as there are decimal places in both factors; e.g.

2.8	1.25	.005	25
8	.6	.03	.06
22.4	.750	.00015	1.50

Find the products:

1. $.18 \times .15$
2. $1.0005 \times .2$
3. $2.5 \times .06$
4. $56 \times .005$
5. $.005 \times 1.6$
6. 25.05×1.15
7. 2.863×100
8. 13.3×1.3
9. $100 \times .01$
10. $100.56 \times .0005$
11. 25.32×1.05
12. $2.84 \times .25$
13. 3.28×1.125
14. 1.111×1000

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ACCOUNTS AND BILLS

When your mother sends you to the store where she is accustomed to buy groceries, giving you no money, and tells you to buy certain articles and have them charged, what does she mean?

The merchant has a book in which he keeps the names of persons to whom he sells things not paid for at the time of the sale, together with a list of the articles sold, their value, and the date of sale. This list is called an **account**.

The person who sells the goods is the **creditor**, *and the person who buys the goods is the* **debtor**. *The debtor and creditor are called* **parties** *to the account.*

A doctor keeps a record of the calls that he makes or receives in treating his patients, when the calls are not paid for at the time. This record is called the patient's account. Who is the creditor? Who is the debtor?

If your father works for some one, he keeps an account of his time and wages. Which party is your father? Which party is the man for whom he works?

At certain times, the creditor copies on a piece of paper a statement of the debtor's account and sends it to the debtor. *This statement is called* a **bill**.

There are various ways of writing a bill, but it should always contain these things:

1. The time and place of making out the bill. This is called the date of the bill.
2. The debtor's name and address.
3. The creditor's name and address.
4. A list of the items — that is, the goods sold, money paid or services rendered, — with the amount of each item.
5. The date of each transaction.
6. The amount, or footing, of the bill.

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(Form 1)

BINGHAMTON, N.Y., June 20, 1918.

MR. JAMES E. DOLAN,
713 Main St.,

Bought of BROWN BROTHERS,
cor. Court and Warren Sts.

2 bu. Apples	$1.10	$2 20	
10 lb. Granulated Sugar	.07½	75	
½ lb. Tea	.50	25	$3 20

What is the date of this bill? Read the items.
Who is the creditor? The debtor?
What is the amount of the bill?
Who ought to pay the bill?
Who should receive the money?

When a bill is paid, the creditor "receipts" the bill by writing at the bottom, "Received Payment," followed by the date and his own name. This shows that the bill has been paid. The debtor keeps the receipted bill to show that the debt has been paid.

When the above bill is paid, who should receipt it?

Make a bill similar to the one given above, but using different items. Find its amount, and receipt it.

Sometimes a clerk, an agent, or a bookkeeper of the creditor receives the money for payment of a bill. He should then write the creditor's name under the words "Received Payment," and under the creditor's name, his own name or initials, thus:

Received Payment,
July 1, 1918.
BROWN BROTHERS,
Per KATE L. BARKER.

Receipt the bill in Form 1 as though you were a clerk for the creditor.

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(Form 2)

SPOKANE, WASH.
April 1, 1919.

MR. W. C. FLINT,
1213 Maxwell Ave.,

To CARROLL SMITH, M.D., *Dr.*
Old National Bank Building.

To professional services rendered, Feb. 25 to March 18, 1919,	$37	50
Received Payment, April 16, 1919. CARROLL SMITH.		

Name each of the parties in this bill. Has the bill been paid? How do you know?

Make out bills of the following items, the teacher being the debtor in each one, and yourself the creditor. Let the teacher examine each bill and mark it O.K. if correctly made. Receipt the bill and return it to the teacher.

1. 3 bu. potatoes at $1.25 per bushel.
   8 lb. lard at 19¢ per pound.
   5 gal. kerosene oil at 18¢ per gallon.

2. 4 lb. coffee at 35¢ per pound.
   18 lb. sugar at 7½¢ per pound.
   5 gal. molasses at 90¢ per gallon.

3. 6 bbl. potatoes at $3.80 per barrel.
   2 tons hay at $16 per ton.
   3 cords wood at $8 per cord.

Make many bills and foot them.

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DIVISION OF DECIMALS

1. One of the factors has two decimal places and the other has five. How many decimal places has the product?

2. When there are five decimal places in one factor and one in the other, how many are there in the product?

3. When there are eight decimal places in the product and five in one factor, how many are there in the other factor? When there are six in the product and four in one factor? Five in the product and three in one factor?

Divide 36.192 by 5.8.

```
      6.24 Quotient
5.8x)36.1x92
     348
      139
      116
      232
      232
```

We first divide as in whole numbers. Since the dividend is a product and the divisor one of its factors, the other factor, or quotient, contains as many decimal places as the number of decimal places in the dividend less the number of decimal places in the divisor.

Mistakes may be avoided by observing the following.

RULE FOR PLACING THE DECIMAL POINT

When the divisor is an integer, place the decimal point in the quotient directly over the decimal point in the dividend (or under in short division).

When the divisor contains decimal places, make a cross after the last figure of the divisor, and another cross in the dividend as many places at the right of the decimal point as there are decimal places in the divisor. Place the decimal point in the quotient directly over the cross in the dividend. This is the same as making the divisor an integer by multiplying both dividend and divisor by the required multiple of 10.

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NOTE 1. — If there is a remainder after all the figures of the dividend have been used, we annex ciphers to the dividend and continue the division until there is no remainder, or until a sufficient number of decimal places have been obtained in the quotient.

NOTE 2. — When the dividend contains fewer decimal places than the divisor, we annex ciphers to the dividend until it has as many decimal places as the divisor.

Written

Find the quotients and test by multiplication:

1. $60.96 \div 1.6$
2. $.00075 \div .05$
3. $25.50 \div .34$
4. $15.2 \div 3.04$
5. $.27560 \div 265$
6. $90.978 \div 3.54$
7. $38.4444 \div 177$
8. $14.4 \div .0018$
9. $1.127 \div 4.9$
10. $.9156 \div 12$
11. $315.432 \div .48$
12. $1.5906 \div .6$
13. $375 \div .125$
14. $125 \div .125$
15. $1000 \div .001$
16. $.001 \div 1000$
17. $25 \div .25$
18. $.25 \div 25$
19. $18.65 \div 100$
20. $266.4 \div .036$
21. $2.107 \div .35$
22. $100.854 \div 3.879$
23. $125874. \div .486$
24. $9801. \div .99$
25. $2976. \div 4.96$
26. $164.32 \div .208$
27. $347.76 \div .368$
28. $.06478 \div .079$
29. $2.5826 \div 69.8$
30. $98.07 \div .210$
31. $20.852 \div .52$
32. $23.322 \div .0026$
33. $676.8 \div .08$
34. $1273.998 \div .199$
35. $357.6 \div 2.98$
36. $.75897 \div 810$

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REVIEW AND PRACTICE

Oral

1. *Read:*

.0305; 42.0042; 4.0004; 6.395; .0600; 639.500; 639.00005; 10.10; $36\frac{3}{8}$; $50.00\frac{5}{8}$.

2. *Express as common fractions in lowest terms:*

.5; .25; .75; $.12\frac{1}{2}$; $.37\frac{1}{2}$; $.87\frac{1}{2}$; $.16\frac{2}{3}$; $.33\frac{1}{3}$; $.62\frac{1}{2}$; $.66\frac{2}{3}$; $.08\frac{1}{3}$; .02.

3. *Divide by* 10:

62; 93.5; 3.44; .25; .0081; .0384; 1.027.

4. *Multiply by* 1000:

8.934; .0245; .612356; 48; 63.05.

5. *Give results:*

436×100; $436 \div 1000$; 436×10; $5 \div 100$; $8314 \div 10{,}000$; $6.183 \times 10{,}000$.

6. *Express as common fractions in lowest terms:*

.4; .60; .8; .500; .70; .200; .600.

7. How may decimals be divided by 10? by 100? by 10,000? by 1000?

8. A stamp clerk received $4085 for special delivery stamps at 10 cents apiece. How many such stamps did he sell?

9. Compare $\$\frac{1}{4}$ with $\$\frac{1}{8}$; $\$\frac{3}{4}$ with $\$\frac{3}{8}$.

10. Compare 1 bushel with $\frac{1}{5}$ of a bushel; 5 bushels with $\frac{5}{5}$ of a bushel.

11. What will 3 months' rent cost at $240 a year?

12. What will a dozen cabbages cost at the rate of 3 for 25¢?

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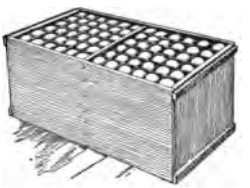
13. *a.* Count the eggs in the top layer of this crate. How many dozen are there?



b. How many such layers are there if the crate contains 30 dozen?

c. $\frac{4}{5}$ of them are how many dozen? How many eggs?

d. $\frac{1}{2}$ of one layer is what fraction of the entire number?

e. How many pounds will a dozen eggs weigh if their average weight is 2 oz. apiece?

f. What is the entire weight of the eggs in the crate?

14. If $\frac{3}{4}$ of a yard of cloth costs 50 cents, what will 3 yards cost? (3 yd. are how many times $\frac{3}{4}$ yd.?)

15. If I borrow one dollar, and agree to pay it back in one year, with 6 cents more to pay for the use of it, how much must I pay in all, at the end of the year?

16. *a.* If you lend me \$8 for a year, and I agree to pay five cents for the use of each dollar, how much will I owe you at the end of the year?

b. How much will I owe if I agree to pay $5\frac{1}{2}$ cents for the use of each dollar? 7 cents? 8 cents? $4\frac{1}{2}$ cents? $6\frac{1}{2}$ cents? 9 cents?

17. *a.* What must I pay for the use of \$20 for one year, if I pay 5 cents for the use of each dollar?

b. If I keep the money three years, paying each year for the use of it, and then pay back the \$20 which I borrowed, how much will I have paid in all?

18. Mr. A borrowed \$9 from Mr. B. After four years he paid it back and also paid 5 cents a year for the use of each dollar. How much did Mr. A pay to Mr. B?

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Written

1. Express as common fractions in simplest form: .125; .625; .025; .5625; .0875; five hundred five thousandths.

2. Express as exact decimals:

$$\frac{7}{8};\ 1\frac{19}{20};\ \frac{7}{16};\ \frac{3}{250};\ 6\frac{5}{64};\ \frac{18}{125}.$$

3. Reduce to decimals of four places:

$$\frac{1}{3};\ \frac{3}{11};\ \frac{11}{12};\ \frac{2}{17};\ \frac{65}{91};\ \frac{14}{25}.$$

4. *Express in figures and add:* Six and forty-five thousandths; forty-nine, and seven hundred seventy-nine thousandths; twenty-four thousand nine hundred, and five hundredths; six hundred five thousandths; three hundred forty-three thousandths; seventy-nine, and five tenths; eleven and thirty-nine hundredths; eight hundred twenty-five, and forty-five hundredths; nine hundred fifteen, and six tenths.

5. From fifteen and twenty-five thousandths take five and six hundred twenty-five millionths. Express the result in words.

6. Find the sum of 3.7, 36.05, .085, and 35.25.

7. From .8 take eight thousandths.

8. Find the sum of .375, $24\frac{1}{6}$, 43.8, and $7\frac{4}{5}$. (Use common fractions.)

9. Find the cost of 6.5 barrels of flour at \$8.75 a barrel.

10. What number divided by $17\frac{3}{8}$ will give 5.05?

11. Add 36.048, 25.13, $13\frac{5}{8}$, and $25\frac{3}{5}$.

12. Find the sum of $\frac{5}{8}$ and .375.

13. A dairyman bought 10.5 tons of hay at \$12.75 a ton. What did it cost?

14. At \$60.75 an acre, what is the cost of 40.25 acres of land?

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15. What is the cost of 8.2 bales of cotton, each bale weighing 412.6 lb., at \$.28 a pound?

16. Two motor cars start from the same place at the same time and go in opposite directions, one at the rate of 15.4 miles an hour, and the other at the rate of 19.8 miles an hour. How far apart are they at the end of $10\frac{1}{4}$ hours?

17. (*a*) What must be paid for the use of \$225 for one year at the rate of 6 cents a year for the use of one dollar? (*b*) For two years? (*c*) For $3\frac{1}{2}$ years?

18. Mr. Scott borrowed \$1500 from Mr. Moore and agreed to pay it back in two years, and also to pay for the use of it at the rate of 5 cents a year for every dollar.

a. How much did Mr. Scott have to pay for the use of the money?

b. How much did he have to pay in all?

19. Solve in the easiest way:

a. If 6 acres of land cost \$438, what will 42 acres cost?

b. How many loads of earth can be bought for \$80 when \$400 will buy 1135 loads?

20. Find how much I will pay in $2\frac{1}{2}$ years for the use of \$2000 if I pay $4\frac{1}{2}$ cents each year for the use of every dollar.

21. Mr. Marvin borrowed \$3500 and paid it five years afterward. He also paid 4 cents each year on every dollar he owed. How much did he pay in all?

22. If I pay at the rate of 7 cents a year for the use of one dollar, how much must I pay for the use of \$2800 for six months? (Six months are what part of a year?)

23. $\frac{7}{19}$ is how many times $\frac{2}{21}$?

24. Divide $\frac{3}{5}$ of $\frac{5}{7}$ of $\frac{4}{9} \times 3\frac{1}{4}$ by $\frac{5}{8}$ of $\frac{11}{25}$ of $\frac{4}{5}$.

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Find:

25. The number of square inches in a map 3 ft. by $4\frac{1}{2}$ ft.

26. The number of barrels of water in a tank containing 378 gallons.

27. The volume of a dry goods box that is $3\frac{1}{2}$ ft. by $2\frac{1}{3}$ ft. by 24 inches.

28. The number of square yards of crash required to cover a floor that is 144 ft. long and 87 ft. wide.

Add:

29.	**30.**	**31.**	**32.**
$73\frac{5}{8}$	$11\frac{7}{9}$	$18\frac{7}{8}$	$342\frac{3}{7}$
$64\frac{2}{3}$	$13\frac{1}{3}$	$97\frac{1}{3}$	$59\frac{1}{3}$
$39\frac{1}{2}$	$62\frac{1}{2}$	$36\frac{1}{6}$	$42\frac{1}{2}$
$42\frac{3}{4}$	$15\frac{2}{3}$	$43\frac{3}{4}$	$38\frac{5}{6}$

33. Express in figures: One thousand one, and one hundred one thousandths.

34. Express in figures: Ten, and ten ten-thousandths.

35. Express in figures: One hundred, and one hundred ten thousandths.

Tell how to solve problems **36** and **37**; then supply numbers and solve them.

36. When telephone poles are set —— rods apart, how many poles are there to a mile?

37. Alice's account for the month shows that she has spent $——, $——, $——, $——, and $——; that she had $—— at the beginning, has earned $——, and received a gift of $——. Balance the account.

38. When you know the cost of 7 articles, how may you find most easily the cost of 21 of the same kind of articles?

39. When you know the quantity that $48 will buy, how may you find most easily the quantity that $6 will buy?

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Find the products and test by division:

1. 3.2×3.6
2. $86 \times .09$
3. $9.8 \times .005$
4. $.039 \times 57$
5. $.00356 \times 6.8$
6. $6394 \times .029$
7. $864 \times .278$
8. $.00967 \times 240$
9. $839.42 \times .0015$
10. 208.7×30.9
11. 930×6.80
12. $4203 \times .0076$
13. $69 \times .00035$
14. $406 \times .0039$
15. 7.92×1.002
16. $7.0001 \times .0603$
17. $43.55 \times .06$
18. $2354 \times .008$
19. 39.04×2.08
20. 6.80×86732
21. $2400 \times .387$
22. $.0406 \times 3080$
23. 920×63.7
24. $.992 \times 3001$
25. $2460 \times .0039$
26. $1234 \times .56$
27. $9.924 \times .0106$
28. $.0204 \times 20.40$
29. $78.08 \times .025$
30. $.8060 \times 300$

Oral

$.7 = \frac{7}{10}$, or 7 divided by 10.
$.305 = \frac{305}{1000}$, or 305 divided by 1000.
$.58\frac{1}{3} = \frac{58\frac{1}{3}}{100}$, or $58\frac{1}{3}$ divided by 100.

In like manner tell the meaning of the following decimals:

1. .8
2. .416
3. .21
4. .3879
5. .200
6. $.89\frac{1}{2}$
7. $.6\frac{5}{9}$
8. $.39\frac{2}{3}$
9. $.48\frac{6}{11}$
10. $.873\frac{1}{3}$
11. $.029\frac{1}{6}$
12. $.007\frac{2}{13}$
13. $.103\frac{2}{3}$
14. $.2134\frac{5}{8}$
15. $.4070\frac{1}{8}$
16. $.05\frac{1}{2}$
17. .034
18. .0165
19. $.00017\frac{1}{2}$
20. $.000\frac{3}{7}$

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CHANGING DECIMALS TO COMMON FRACTIONS OR MIXED NUMBERS

$$.072 = \frac{72}{1000} = \frac{9}{125}$$
$$18.25 = 18\frac{25}{100} = 18\frac{1}{4}$$

Reduce to common fractions or mixed numbers in simplest form:

1. .8	8. .125	15. 16.75
2. .25	9. .875	16. .00125
3. .35	10. .375	17. .054
4. .75	11. .455	18. .0250
5. .64	12. .025	19. .01375
6. .52	13. .561	20. $.34\frac{2}{7}$
7. .38	14. .368	

SOLUTION: $.34\frac{2}{7} = 34\frac{2}{7} \div 100 = \frac{240}{7} \times \frac{1}{100} = \frac{12}{35}$. *Ans.*

21. $.12\frac{1}{2}$	31. $2.33\frac{1}{3}$	41. $.16\frac{2}{3}$
22. $.62\frac{1}{2}$	32. $.3\frac{1}{7}$	42. $.19\frac{7}{12}$
23. $.06\frac{1}{4}$	33. $42.62\frac{1}{2}$	43. $.562\frac{1}{2}$
24. $.18\frac{1}{8}$	34. $97.087\frac{1}{2}$	44. $400.40\frac{5}{7}$
25. $.03\frac{3}{4}$	35. $56.13\frac{1}{3}$	45. $361.41\frac{1}{9}$
26. $.25\frac{4}{5}$	36. $158.06\frac{1}{4}$	46. $2042.1\frac{5}{6}$
27. $.87\frac{1}{2}$	37. $409.6\frac{7}{8}$	47. $79.00\frac{5}{9}$
28. $.66\frac{2}{3}$	38. $.07\frac{3}{11}$	48. $308.00\frac{25}{36}$
29. $.36\frac{7}{8}$	39. $.26\frac{2}{3}$	49. $2890.90\frac{4}{9}$
30. 16.25	40. $.012\frac{8}{7}$	50. $98.000\frac{40}{41}$

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Oral

Using aliquot parts, reduce the following to mixed numbers:

1. \$58.50	6. \$6.05	11. $15.08\frac{1}{3}$
2. $\$39.33\frac{1}{3}$	7. $\$32.12\frac{1}{2}$	12. $422.33\frac{1}{3}$
3. $\$5.16\frac{2}{3}$	8. \$19.10	13. $100.14\frac{2}{7}$
4. \$7.25	9. $\$18.14\frac{2}{7}$	14. $603.16\frac{2}{3}$
5. \$19.20	10. 16.02	15. 99.02

At sight, reduce the following to common fractions or mixed numbers:

1. $.62\frac{1}{2}$	4. 12.875	7. $29.87\frac{1}{2}$	10. 43.4
2. $.66\frac{2}{3}$	5. 13.02	8. 3.6	11. $12.37\frac{1}{2}$
3. .75	6. 430.625	9. 7.8	12. 54.375

CHANGING COMMON FRACTIONS AND MIXED NUMBERS TO DECIMALS

Written

Change $\frac{5}{16}$ to a decimal.

$$
\begin{array}{r}
.3125 \\
16\overline{)5.0000} \\
\underline{48} \\
20 \\
\underline{16} \\
40 \\
\underline{32} \\
80 \\
\underline{80}
\end{array}
$$

$\frac{5}{16} = 5 \div 16 = .3125$. *Ans.*

Write $9\frac{5}{16}$ as a mixed decimal.

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Reduce to decimals:

1. $\frac{4}{5}$	11. $\frac{12}{40}$	21. $\frac{47}{64}$	31. $19\frac{19}{125}$
2. $\frac{3}{4}$	12. $\frac{9}{16}$	22. $\frac{38}{64}$	32. $\frac{1}{625}$
3. $\frac{4}{25}$	13. $\frac{1}{8}$	23. $\frac{43}{80}$	33. $\frac{7}{125}$
4. $\frac{7}{8}$	14. $\frac{56}{25}$	24. $\frac{17}{20}$	34. $12\frac{6}{625}$
5. $\frac{3}{20}$	15. $3\frac{1}{16}$	25. $13\frac{7}{20}$	35. $14\frac{29}{80}$
6. $\frac{2}{5}$	16. $\frac{3}{8}$	26. $19\frac{7}{16}$	36. $9\frac{9}{125}$
7. $\frac{3}{5}$	17. $\frac{3}{80}$	27. $12\frac{9}{25}$	37. $13\frac{1}{40}$
8. $\frac{5}{32}$	18. $\frac{8}{25}$	28. $\frac{11}{50}$	38. $2\frac{21}{250}$
9. $\frac{7}{16}$	19. $\frac{15}{20}$	29. $\frac{23}{40}$	39. $5\frac{8}{32}$
10. $\frac{54}{36}$	20. $2\frac{3}{32}$	30. $\frac{87}{125}$	40. $\frac{23}{320}$

A fraction in lowest terms whose denominator contains other prime factors than 2 and 5 cannot be reduced to an exact entire decimal; e.g. $\frac{2}{3}$, $\frac{5}{6}$, $\frac{15}{22}$, $\frac{8}{11}$, $\frac{19}{26}$, $\frac{41}{35}$.

Such a fraction may be reduced to a decimal of nearly the same value by carrying the division to a certain number of decimal places, thus:

Reduce $\frac{19}{26}$ to a decimal of four places.

$.7307\frac{9}{13}$ *Ans.*

$$
\begin{array}{r|l}
26.\overline{)19.0000} & \\
\underline{182} & \\
80 & \frac{18}{26} = \frac{9}{13} \\
\underline{78} & \\
200 & \\
\underline{182} & \\
18 &
\end{array}
$$

.7307 is almost equal to $\frac{19}{26}$.
The exact value of $\frac{19}{26}$ is $.7307\frac{9}{13}$.
The result may be expressed, .7307+.

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Written

Reduce to decimals of three places:

1. $\frac{1}{8}$	7. $\frac{14}{31}$	13. $8\frac{7}{15}$	19. $42\frac{10}{29}$
2. $\frac{5}{7}$	8. $\frac{5}{48}$	14. $23\frac{1}{9}$	20. $\frac{236}{388}$
3. $\frac{2}{11}$	9. $\frac{12}{17}$	15. $681\frac{4}{11}$	21. $\frac{855}{275}$
4. $\frac{5}{6}$	10. $\frac{143}{19}$	16. $3\frac{8}{17}$	22. $43\frac{5}{42}$
5. $\frac{4}{7}$	11. $\frac{1}{240}$	17. $\frac{22}{23}$	23. $16\frac{9}{71}$
6. $\frac{8}{13}$	12. $15\frac{2}{9}$	18. $\frac{50}{61}$	24. $\frac{256}{301}$

A Common Fraction at the End of a Decimal

$.2\frac{1}{2} = .2 + (\frac{1}{2}$ of $\frac{1}{10}$, or $\frac{1}{20}$, or $.05)$.
$.2 + .05 = .25$.

In a similar manner, we may show that
$7\frac{1}{2} = .275$, $.384\frac{1}{2} = .3845$, etc.

Also, that $.2\frac{1}{4} = .225$, $.34\frac{1}{4} = .3425$, etc.
Also, that $.8\frac{3}{4} = .875$, $.06\frac{3}{4} = .0675$, etc.
Also, that $.9\frac{1}{8} = .9125$, $.07\frac{3}{8} = .07375$, etc.

Oral

Express as entire decimals:

1. *a.* $.2\frac{1}{2}$	*b.* $\$.17\frac{1}{2}$	*c.* $.360\frac{1}{2}$	*d.* $7\frac{1}{2}$	*e.* $.004\frac{1}{2}$
2. *a.* $.8\frac{1}{4}$	*b.* $3.7\frac{1}{4}$	*c.* $\$9.20\frac{1}{4}$	*d.* $\$.39\frac{1}{4}$	*e.* $.145\frac{1}{4}$
3. *a.* $.05\frac{3}{4}$	*b.* $1.1\frac{3}{4}$	*c.* $\$21.46\frac{3}{4}$	*d.* $.033\frac{3}{4}$	*e.* $.090\frac{3}{4}$
4. *a.* $.7\frac{1}{4}$	*b.* $6.8\frac{1}{2}$	*c.* $80.3\frac{1}{2}$	*d.* $12\frac{3}{4}$	*e.* $1.9\frac{1}{4}$
5. *a.* $.42\frac{1}{2}$	*b.* $3.97\frac{1}{2}$	*c.* $150\frac{3}{4}$	*d.* $24.0\frac{1}{2}$	*e.* $29.0\frac{1}{4}$
6. *a.* $1.30\frac{3}{4}$	*b.* $2.45\frac{3}{4}$	*c.* $100\frac{1}{2}$	*d.* $20\frac{3}{4}$	*e.* $40.00\frac{1}{2}$

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REVIEW AND PRACTICE

(For class drill, not for assignment.)

Oral

1. What three numbers multiplied together equal 12?

2. What dimensions could a cake of maple sugar have to contain 12 cubic inches?

3. $4 \times 3 \times ? = 24$. A block of wood 4 in. long and 3 in. wide must be how thick to contain 24 cubic inches?

4. What dimensions could a box have to hold 36 cu. ft. of coal?

5. What dimensions could a box have to hold: (*a*) 40 inch-cubes? (*b*) 18 inch-cubes? (*c*) 32 inch-cubes?

6. A box is 4 in. wide and $1\frac{1}{2}$ in. deep. It contains 72 cubic inches? How long is it?

7. How many inch-cubes are equal to a rectangular prism 3 in. by 2 in. by 5 in.?

8. $24 \div 10 = ?$
9. $342 \div 100 = ?$
10. $439 \div 1000 = ?$
11. $12.3 \div 100 = ?$
12. $42.1 \div 100 = ?$
13. $82.4 \div 1000 = ?$
14. $2.3 \times 10 = ?$
15. $83 \times 100 = ?$
16. $8.3 \times 100 = ?$
17. $4.283 \times 100 = ?$
18. $6.934 \times 1000 = ?$
19. $400.9 \times 100 = ?$

What common fraction is equal to:

20. $.33\frac{1}{3}$
21. .50
22. .25
23. .250
24. .6
25. .60
26. $.62\frac{1}{2}$
27. .2
28. .75
29. $.16\frac{2}{3}$
30. $.37\frac{1}{2}$
31. $.87\frac{1}{2}$

What decimal is equal to:

32. $\frac{1}{2}$
33. $\frac{1}{3}$
34. $\frac{1}{4}$
35. $\frac{1}{5}$
36. $\frac{1}{6}$
37. $\frac{3}{4}$
38. $\frac{3}{8}$
39. $\frac{5}{8}$
40. $\frac{7}{8}$
41. $\frac{3}{5}$
42. $\frac{2}{3}$
43. $\frac{4}{5}$

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Written

1. A lady purchased $4\frac{1}{2}$ yd. of silk at \$1.25 per yard and $7\frac{1}{4}$ yd. of broadcloth at \$3.50 per yard. What change should she receive from a \$20 bill and two \$10 bills?

2. The daily traveling expenses of the 16 salesmen of a manufacturing company amount to \$168.80. What is the average per man?

3. Divide 53.66523 by .941.

4. $28.8 \div .0072 = ?$

5. Divide .305996 by .337.

6. Divide 990 by .11.

7. \$87.50 will pay for how many piano lessons at \$1.25 a lesson?

8. $207.09 \div .015 = ?$

9. A boy's height increased 1.4 inches in his 12th year, 1.5 inches in his 13th year, and 1.6 inches in his 14th year. What was his average growth per year for the three years?

10. A farmer received $\$146\frac{1}{4}$ for pigs at $\$3\frac{1}{4}$ apiece. How many pigs did he sell?

11. The smaller of two numbers is 9346.05. Their difference is 412.08. What is the greater?

12. $9.2 \times 5.37 - (1.785 + .1318) = ?$

13. The following quantities of stamps were sold during a year at a city post office. Find what was received for all of them:

1-cent . .	4,832,500	6-cent . .	40,000
2-cent . .	10,550,000	8-cent . .	47,100
3-cent . .	15,117,500	10-cent . .	70,200
4-cent . .	161,000	13-cent . .	3400
5-cent . .	198,000	15-cent . .	8800

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14. Yesterday you bought from your grocer 60 lb. of sugar at $7\frac{1}{2}¢$ per pound, 60 clothespins at $8¢$ per dozen, and $\frac{1}{8}$ of a barrel of flour at \$8.64 per barrel. To-day you paid the bill, and the grocer receipted it and gave it to you to take home. Write a copy of the bill.

15. A merchant bought a piece of cloth containing $59\frac{1}{4}$ yd. at $37\frac{1}{2}¢$ a yard. Find the cost.

16. Divide .1024 by the product of .064 and .01.

17. How many cubic yards of earth must be removed to make an excavation 123 ft. by 24 ft. by 12 ft.?

18. A mile is 5280 ft. A rod is $16\frac{1}{2}$ ft. What can you find from these numbers? Find it.

19. The product of .85 and another number is 1.7. Find the other number.

20. Find the number of cubic inches in a cube of ice $1\frac{1}{2}$ ft. by $2\frac{1}{3}$ ft. by $1\frac{1}{4}$ ft.

21. Make bills of the following items, making the R. M. Brown Co. creditor and your teacher the debtor. Receipt the bills as though you were agent for the creditor.

a. 16 yd. silk at \$1.50 per yard.
4 pairs hose at $50¢$ per pair.
9 yd. lace at $60¢$ per yard.

b. 1 chocolate pot, $75¢$.
6 salad plates at \$1.10 each.
15 Haviland bouillon cups at \$12 per doz.
1 bread plate, $98¢$.

22. Divide $1\frac{3}{5}$ of $\frac{9}{11}$ by $3\frac{2}{3}$ times $1\frac{7}{11}$.

23. A retail fish merchant bought, at $11\frac{1}{2}$ cents a pound, a barrel of fish containing 243 lb. He sold it at $18¢$ a pound. 25 lb. spoiled before it could be sold. Make and solve five problems, using these facts.

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PROBLEMS FROM THE NAVY

PART OF AN AMERICAN WAR FLEET

BATTLESHIPS

NAME	LENGTH	TONNAGE	NO. OF GUNS	SPEED IN KNOTS PER HOUR	OFFICERS AND MEN
California . .	624	32,300	34	21	1083
Tennessee . .	624	32,300	34	21	1083
Pennsylvania .	608	32,567	38	21	929
Nevada . . .	583	28,400	25	20.05	912
Texas	573	28,367	25	21.05	1074
New York . .	573	28,367	35	21	1074
Arkansas . .	562	27,243	39	21.05	1101
Wyoming . .	562	27,243	37	21.22	1051
Utah	521	23,033	30	21.04	994
Florida . . .	521	23,033	30	22.08	994
N. Dakota . .	519	22,060	28	21.01	944
Delaware . .	519	22,060	28	21.56	874

ARMORED CRUISERS

West Virginia .	504	15,981	42	22.26	955
Washington . .	504	15,981	42	21.91	955
Colorado . .	504	15,712	42	22.27	951
Maryland . .	504	15,138	36	22.24	889

1. If all these ships were formed in a single unbroken line, how many feet long would the line be?

2. How many miles long would it be?

3. What is the average tonnage?

4. How many guns do they all carry?

5. How many men are there on all the ships?

6. How many knots greater is the average speed of the cruisers than of the battleships?

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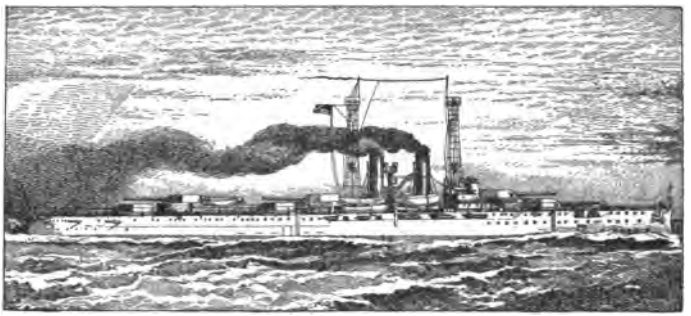

7. What is the average number of men on a ship? (See tables on page 171.)

8. A knot, or nautical mile, is used in measuring the speed of vessels. It is equal to about 1.15 common or statute miles.

9. The *California's* speed is how many common miles per hour?

10. The *South Dakota's* speed per hour is how many common miles greater than the *Tennessee's?*

11. How many common miles farther can the cruiser *Washington* sail in an hour than the battleship *New York?*

12. If the *Pennsylvania* is 9.9 knots ahead of the *Delaware,* and both ships are moving at their highest speed, in how many hours can the *Delaware* overtake the *Pennsylvania?*

13. How many common miles can the *Utah* go in 24 hours, if she goes 21.4 knots per hour all the time?

14. How many feet can the *Arkansas* go in 1 minute?

Make other problems about these warships, using the numbers given in the table.

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FACTORS AND PRODUCT

In the greater part of the computation work of arithmetic, the relation of factors and product appears. For example, when we know the cost of one article and the number of articles purchased, we find the cost of all by multiplication. That is to say, the number of articles and the cost of one are factors and the cost of all is their product.

If the cost of all and the cost of one are given, the product and one factor are given, and the other factor is found by division. When the cost of all and the number of articles are known, the cost of one article may be found by division.

In every case, then, involving the relation of product and factors, the only thing needful, in order to decide upon the process, is to determine which terms are given and which one is to be found; thus,

1. At 30¢ apiece, 10 arithmetics will cost $10 \times 30¢$ (factors), or $3.00 (product).

2. When 10 (factor) baseball suits cost $47.50 (product), one suit will cost $47.50 ÷ 10, or $4.75 (factor).

3. When $\frac{2}{5}$ *of Paul's earnings are $1.50,* how much does he earn?

STATEMENT OF THE PROBLEM: $\frac{2}{5}$ of (Paul's earnings) are $1.50
or, $\frac{2}{5} \times$? = $1.50
SOLUTION: 1.50 (product) ÷ $\frac{2}{5}$ (given factor) = $2.50 (other factor).

4. *.35 of the cost of a piano is $70.* What does the piano cost?

STATEMENT OF THE PROBLEM: .35 of (cost of piano) is $70
or, .35 × ? = $70
SOLUTION: 70 ÷ .35 = 200. $200 *Ans.*

5. When *$1200 is $\frac{3}{8}$ of the value of a house,* what is the house worth?

STATEMENT OF THE PROBLEM: $1200 is $\frac{3}{8}$ of (value of house)
or, $1200 = $\frac{3}{8} \times$ (value of house)
SOLUTION: 1200 (product) ÷ $\frac{3}{8}$ (one factor) = $3200 (other factor).

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COMPUTING IN HUNDREDTHS

Decimals in hundredths are used very generally in business calculations. The merchant computes his gain or loss as a certain number of hundredths of the cost or selling price of the goods. Banks compute interest in hundredths. The relations of numbers are expressed generally in hundredths.

Problems involving computation in hundredths usually present one of the two questions of relation between product and factors, namely:

a. Two factors given, to find the product, or,

b. The product and one factor given, to find the other factor; *e.g.*

1. .25 of \$30 is how much money?

The question may be stated, .25 × \$30 = ?

SOLUTION: .25 × \$30 = \$7.50

2. *.35 of Frank's money is \$7.00.* How much has he?

STATEMENT OF THE PROBLEM: .35 of (Frank's money) is \$7.00

or, .35 × ? = \$7.00

Observe that we use the × sign, which means "of," and we use the sign =, which means *is*. Observe also that 7.00 is a product and .35 one of its factors. How may the other factor be found?

SOLUTION: 7.00 ÷ .35 = 20. \$20. *Ans.*

3. Leona had \$1.80 and spent \$.36 for a box of paper. How many hundredths of her money did she spend?

STATEMENT OF THE PROBLEM: (How many hundredths) of \$1.80 is \$.36, or, ? × \$1.80 = 36.

SOLUTION: .36 ÷ 1.80 = .20. *Ans.*

Which number is a product? Which are factors?

4. Give the solution for each of the following:

a. STATEMENT OF THE PROBLEM: .85 of \$5.00 is (cost of Fred's shoes).

b. STATEMENT OF THE PROBLEM: .75 of (cost of John's skates) is \$2.25.

c. STATEMENT OF THE PROBLEM: How many times 2.16 is .54?

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In the following problems give the *Statement of the Problem* and the *Solution* as on page 174.

Observe that the *Statement* can be found right in the problem as printed in the book.

1. $7\frac{1}{2}$ days are how many hundredths of the month of June?

STATEMENT OF THE PROBLEM: $7\frac{1}{2}$ days are (how many hundredths) of 30 da., or, $7\frac{1}{2} = ? \times 30$.

(The product may be at the left as well as at the right of the (=) sign.)

2. *.90 of the pupils in a class were* promoted. If *36 pupils* were promoted, how many were there in the class?

3. It cost \$24 to decorate a room. The labor cost *\$18. How many hundredths of the \$24 were* for labor?

4. A farmer's crop of apples amounted to *960 bushels; 864 bushels were* fit for market. *How many hundredths* of the crop were fit for market?

5. A speculator sold some property for \$78,000 and invested *.33$\frac{1}{3}$ of the money* in grain.

a. How much did he invest in grain?

b. (*How many hundredths*) *of his money* were *left?*

6. *How many hundredths of \$142.60 is \$7.13?*

7. *24 quarts are how many hundredths of six bushels?*

8. A grocer bought 8 bushels of potatoes for \$6 and sold them for \$7.80. He gained how many hundredths of the cost? (First think *how much* he gained.)

9. *.85 of* (*a certain number*) *is 595.* What is the number?

10. A boy paid .24 of his money for books, .07 of his money for stationery, and .22 of his money for a football. If he then had \$3.76 left, how much had he at first?

(First find how many hundredths he spent, then how many hundredths he had left; then give the *Statement of the Problem.*)

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11. Mr. Markell bought a house for $4200 and sold it for $4830. How many hundredths of the cost did he gain?

(First find how much money he gained; then give the *Statement of the Problem.*)

12. 24 qt. are how many hundredths of a bushel?

13. A farm worth $4500 rents for .05 of its value. For how much does the farm rent?

14. Dr. Smith sold his motor car for $1860, which was .66⅔ of its cost. What did it cost?

15. The list price of baseball suits was $4.75 apiece. Our team bought 11 suits for .80 of the list price. How much did they cost?

NOTE. — *The price at which goods are marked in the price list* is called **list price.**

16. Mr. Arnold's salary is $1600. He saves $250. How many hundredths of his salary does he save?

17. A contractor makes concrete by mixing 5 bbl. of cement, 10 bbl. of sand, and 25 bbl. of crushed stone.

a. How many hundredths of the mixture is (*a*) cement? (*b*) sand? (*c*) crushed stone?

18. Eight quarts are how many hundredths of 32 quarts?

19. Mr. Saunders bought a farm for $12,000 and sold it for $15,000. How many hundredths of the cost did he gain?

20. 475 pupils were promoted from the eighth grade of our city schools last year, and 400 of them entered the high school. How many hundredths of them did not enter the high school?

21. Make and solve five problems in hundredths.

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PERCENTAGE

Per cent is *another name for hundredths.* Six per cent means six hundredths; ten and one half per cent means ten and one half hundredths. The *number of hundredths* is also called the **rate per cent.**

TO THE TEACHER. — It is important that pupils obtain at the outset a clear and definite concept of *per cent* as *hundredths.* Do not make the mistake of introducing the fractional equivalent too soon. Ample provision for that is made farther along in the course. Be content to use *hundredths* until pupils recognize the three types of problems instantly. *"One new idea at a time, and first the fundamental, general idea"* is a good maxim here.

Instead of writing the words *per cent,* the sign % is used; thus,

5 % of \$8 means .05 × \$8 or \$.40
12½ % of 4 in. means .12½ × 4 in. or .50 in.
108 % of \$12 means 1.08 × \$12 or \$12.96

Oral

As above, tell the meaning of each of the following expressions and find its value:

1. 8 % of 50
2. 50 % of 200
3. 12 % of 100 miles
4. 10 % of 60 sheep
5. 50 % of 300 men
6. 2 % of 30 bushels
7. 25 % of 64 days
8. 10 % of 150 bushels
9. 1 % of \$2100
10. 5 % of 100 boys

Written

Find:

1. 50 % of \$349.20
2. 33 % of \$24.80
3. 9 % of 34½
4. 15 % of 2340 ft.

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1. There were 50 words in the spelling test. Dorothy spelled 98% of them correctly. How many did she have right?

STATEMENT OF THE PROBLEM: 98 % of 50 words = ?
SOLUTION: .98 × 50 = 49. 49 words. *Ans.*

2. In a school of 660 pupils, 55% were girls. How many were girls?

3. 45% of a class of 40 pupils were boys. How many were girls?

4. In one day a grocer sold 14⅔% of a barrel of sugar, containing 350 lb. How many pounds did he sell?

5. Mr. James owns a house worth $5500. It rents for 12% of its value. What is the rent?

6. A man's house and furniture are insured for $3600. 20% of this insurance is on the furniture. What is the insurance on the furniture?

7. Mr. French borrowed $725 from Mr. Rich, and paid him 6% of that sum for the use of it. How much was paid for the use of the $725?

8. A bushel of potatoes weighs 60 lb. If 75% of this weight is water, how many pounds of water are there in a bushel of potatoes?

9. The deposits in the School Savings Bank of our city are $57,869.20. The deposits of Irving school are 9½% of this. What is the amount of Irving school's deposits?

10. If 33% of the coal used on a railroad is wasted in burning, how many pounds are wasted in each ton?

11. A merchant bought coats at $168 a dozen and sold them at a profit of 40% of the cost.

a. What was his profit on a dozen?
b. For what did he sell a dozen?
c. What did he receive for one coat?

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The problems on page 174 represent the type form in which every problem in percentage may be expressed, namely: —— % of —— = —— or, —— = —— % of ——. In the problems on page 178 the rate per cent and the number of which the rate per cent is to be found are given (two factors) and their product is to be found. We shall now consider problems in which the product and one factor are given and the other factor is to be found.

12. Mr. Archer puts 20% of his wages in the bank. If he puts $18 in the bank every month, what are his monthly wages?

STATEMENT OF THE PROBLEM: 20% of (monthly wages) is $18
or, .20 × ? = $18

SOLUTION: 18 ÷ .20 = 90. $90. *Ans.*

(Observe that the *Statement of the Problem* is found right in the problem itself and we merely "pick it out" as we pick out the meat from a walnut. The second statement (20 × ? = 18) merely reduces the first one to arithmetical terms.

13. Donald gave his mother $3.75, which was 75% of his week's wages. How much a week did he receive?

STATEMENT OF THE PROBLEM: $3.75 was 75% of (his wages).
or, 3.75 = .75 × ?

SOLUTION: 3.75 ÷ .75 = 5. $5. *Ans.*

Observe that in this case it is easier to "read the statement" out of the given problem by putting the product first. Use each time whichever method is the more convenient.

14. Mr. Williams has 40 acres of timber land. This is 25% of all his land. How many acres has he?

15. A man borrowed some money and paid $75 for the use of it. If that was 5% of the sum borrowed, how much was borrowed?

16. It costs a man $1200 to support his family for a year. If this is 80% of his salary, what is his salary?

17. 60% of a class were boys. (*a*) If there were 21 boys, how many pupils were there in the class? (*b*) How many were girls?

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18. The Hamilton school baseball team played 24 games and won 18 games. What per cent of the games played were won by this team?

Consider the last sentence: "*What per cent of the games played were won?*"

STATEMENT OF THE PROBLEM: ——% of 24 games are 18 games

or, ? × 24 = 18

SOLUTION: 18 ÷ 24 = .75 or 75%. *Ans.*

$$\begin{array}{r} .75 \\ 24\overline{)18.00} \\ \underline{168} \\ 120 \\ 120 \end{array}$$

19. What per cent of $38 is $24.70?

Reading hundredths instead of per cent, the question is, "How many hundredths of $38 is $24.70?"

STATEMENT OF THE PROBLEM: ——% of $38 is $24.70

or, ? × 38 = 24.70

SOLUTION: $24.70 ÷ $38. = .65 or 65%. *Ans.*

Observe that the steps in solving percentage problems are:

a. Copy the statement of the problem.

b. Repeat it, using the decimal for % and the sign (×) for *of*.

c. Make the solution.

As observed on page 179, the product may be on either side of the equality sign; *e.g.*

20. What per cent of $240 is $80?

or, ? × 240 = 80.

SOLUTION: 80 (product) ÷ 240 (factor) = —— (factor).

21. 7 bushels are what per cent of 8.5 bushels?

STATEMENT OF THE PROBLEM: 7 bushels are ——% of 8.5 bushels.

or 7 = ? × 8.5

SOLUTION: 7 (product) ÷ 8.5 (factor) = —— (factor).

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In finding the per cent, or number of hundredths, how many decimal places must there be in the quotient? Then how must the number of decimal places in the dividend compare with the number of decimal places in the divisor?

Summary

Before dividing, to find the rate per cent, arrange the dividend and divisor so that the dividend contains two more decimal places than the divisor. This may be done by annexing ciphers to one or the other of these terms, as may be necessary.

If the quotient is not exact when two decimal places have been reached, express the remainder as a common fraction, in the quotient.

22. 150 is what per cent of 900?

23. What per cent of $113 is $39.55?

24. Find what per cent 495 years is of 825 years.

25. Find what per cent 12.96 feet is of 96 feet.

26. Mr. Adams works 8 hr. every day. He works what per cent of the time?

27. Your father bought 10 T. of coal. At Christmas, he had used 4 T. What per cent of the coal had he used?

28. If 1 T. of sugar beets contains 200 lb. of sugar, what per cent of the beets is sugar?

29. A merchant bought a case of eggs containing 360 eggs in all. 234 of them graded as "firsts," 108 as "seconds," and 18 were cracked.

a. What per cent of the eggs were firsts?

b. What per cent were seconds?

c. What per cent were cracked?

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30. A piece of meat weighed 12 lb. before cooking and $8\frac{1}{2}$ lb. after cooking. What per cent of its weight was lost in cooking?

31. The team standings of the National Baseball League on the 13th of September were as given in the table below. Complete the table by finding the per cent won of games played by each team:

Team	Won	Lost	% Won	Team	Won	Lost	% Won
Brooklyn	78	53		Pittsburgh	63	69	
Philadelphia	76	53		Chicago	60	73	
Boston	73	54		St. Louis	57	77	
New York	64	62		Cincinnati	52	81	

Note. — Care should be taken to express the decimal rate per cent properly, as hundredths. Every fractional part of 1% must be written at the right of the hundredths' place.

1% = .01	$12\frac{1}{2}\% = .12\frac{1}{2}$ or .125
9% = .09	$\frac{1}{2}\% = .00\frac{1}{2}$ or .005
10% = .10	$10\frac{7}{10}\% = .10\frac{7}{10}$ or .107
90% = .90	$33\frac{1}{3}\% = .33\frac{1}{3}$
100% = 1.00	$8\frac{1}{4}\% = .08\frac{1}{4}$ or .0825
125% = 1.25	$\frac{1}{8}\% = .00\frac{1}{8}$ or .00125

Written

Express decimally:

1. 7%	6. $6\frac{1}{4}\%$	11. 101%	16. $\frac{1}{2}\%$
2. 6%	7. $12\frac{1}{2}\%$	12. 110%	17. $\frac{3}{4}\%$
3. 2%	8. $15\frac{3}{4}\%$	13. 250%	18. $\frac{2}{5}\%$
4. 12%	9. $37\frac{1}{2}\%$	14. 200%	19. $\frac{5}{8}\%$
5. 78%	10. $4\frac{5}{8}\%$	15. $127\frac{1}{2}\%$	20. $\frac{18}{20}\%$

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Find:

21. 40% of 120
22. $12\frac{1}{2}$% of 160 lb.
23. $18\frac{2}{5}$% of 365
24. 36% of 250 yd.
25. 35% of 700 pupils
26. $\frac{1}{2}$% of \$90
27. $16\frac{2}{3}$% of 66 miles
28. 48% of \$8.50
29. *Statement of the Problem:* 6.8 is 17% of what?
or, $6.8 = .17 \times ?$
Solution: $6.8 \div .17 = 40$. 40 *Ans.*

Copy each of the following statements, reduce it to arithmetical terms, and write the solution, as above:

30. \$3.95 is 5% of what?
31. \$289 is 50% of what?
32. $2\frac{1}{2}$% of 75 dozen are how many dozen?
33. 5% of what is \$5?
34. What per cent of \$920 is \$230?
35. What is $8\frac{1}{2}$% of 690 lb.?
36. ——% of 85 lb. is 17 lb.?
37. 45 bushels are 90% of what?
38. 70% of what distance is $3\frac{1}{2}$ mi.?
39. 15 min. are what per cent of 25 min.?
40. *a.* 1 quart is what per cent of 4 quarts?
b. 1 quart is what per cent of 1 gallon?
41. What is $18\frac{1}{2}$% of 362?
42. 3.71 is 25% of what number?
43. 15% of what number is 10.50?
44. What is $1\frac{7}{8}$% of 640?
45. $37\frac{1}{2}$% of what equals 15 lb.?
46. 35 yd. are what per cent of 105 yd.?
47. 75% of the cost of a farm is \$4200.
48. 35% of my money is \$700.
49. 10 min. is what per cent of 1 hr.?

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PROBLEMS IN PERCENTAGE

1. 920 lb. or 23% of a load of grain is wheat. How many pounds does the load weigh?

2. (*a*) In a baseball game, Fred's team scored 14 runs. If Fred made 2 runs, what per cent of the 14 runs did he make? (*b*) If the other team made 6 runs, what per cent of all the runs did Fred's team make?

3. A bat and ball cost \$1.50. If $33\frac{1}{3}\%$ of this sum was paid for the bat, what did the ball cost?

4. A huckster bought berries at 8¢ a quart and sold them at 12¢. His gain was what per cent of the cost?

5. 35 gallons of Jersey milk contained 8.05 gallons of cream. What per cent of the 35 gallons was cream?

6. A man lost \$127.50 by selling a village lot. If this was 15% of the cost, what did the lot cost?

7. A merchant sold goods for \$25.63 less than the marked price. If this reduction was 10% of the marked price, what was the marked price?

8. A grocer bought a crate of cherries containing 32 quarts for \$2.88. He sold them at 12 cents a quart. His gain was what per cent of the cost?

9. 84.20 is what per cent of 421?

10. Find $\frac{3}{5}\%$ of \$5600.

11. Find $66\frac{2}{3}\%$ of 927 tons.

12. 54 is what per cent of 900?

13. 386% of 244 = what?

14. $23\frac{1}{3}\%$ of a number is 7000. Find the number.

15. The entire amount raised by tax in a city this year is \$125,700. Of that sum \$41,900 is used to maintain the schools. From these statements make a percentage problem and solve it.

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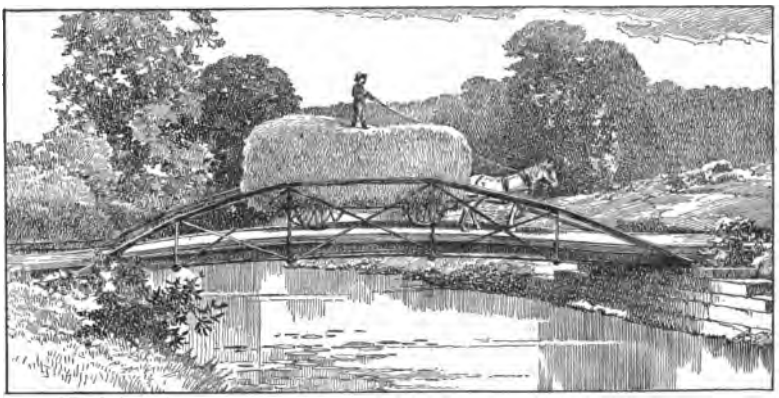

16. This load of hay weighs 2200 lb., the wagon 1200 lb., and the team 2600 lb. (*a*) The weight of the hay is what per cent of the entire weight? (*b*) The weight of the wagon is what per cent of the entire weight? (*c*) The weight of the team is what per cent of the entire weight? (*d*) How many tons must the bridge support?

REVIEW AND PRACTICE

Give results rapidly: (Oral)

1. $36 + 48$ (Say "36, 76, 84."); $43 + 25$; $81 + 19$
2. $93 - 24$ (Say "93, 73, 69."); $82 - 19$; $48 - 28$
3. $60¢ + ? = \$1.00$; $25¢ + ? = \$2.00$; $71¢ + ? = \$100$
4. 20×20; 25×6; $33\frac{1}{3} \times 3$; 40×8
5. $12 \times ? = 108$; $? \times 15 = 60$; $36 \times ? = 72$
6. $\frac{3}{4} + \frac{1}{2}$; $\frac{5}{6} + \frac{1}{4}$; $\frac{7}{9} + \frac{1}{3}$; $\frac{1}{4} + \frac{1}{6}$; $\frac{2}{5} + \frac{1}{2}$
7. $\frac{1}{2}$ of $\frac{3}{4}$; $1\frac{1}{2} \times \frac{5}{6}$; $1\frac{1}{3} \times 2\frac{1}{2}$; $\frac{3}{8} \times \frac{4}{9}$
8. $\frac{2}{3} = \frac{?}{33}$; $\frac{5}{7} = \frac{?}{14}$; $\frac{3}{4} = \frac{?}{100}$; $\frac{5}{8} = \frac{?}{32}$
9. $\frac{2}{3} \div 5$; $2\frac{1}{2} \div 10$; $3\frac{1}{3} \div 4$; $4\frac{1}{5} \div 7$
10. $\$.25 \times 8$; $\$.33\frac{1}{3} \times 3$; $.62\frac{1}{2} \times 8$; $.66\frac{2}{3} \times 3$
11. Give Roman numerals for 12; 15; 28; 45; 81; 99.

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12. 15×10; 32×100; 4×1000; 58×1000; 90×100

13. 4.5×10; 7.1×100; 3.45×10; $.84 \times 1000$

14. 4 gal. of gasoline at $22\frac{1}{2}¢$ per gal. cost how much?

15. 5 gal. of gasoline cost \$1.15. What was the price per gallon?

16. $253 \div 10$; $341 \div 100$; $7 \div 100$; $832 \div 1000$; $47.5 \div 1000$

17. What is the cost of a dozen garden hoes at $33\frac{1}{3}¢$ each?

18. At $25¢$ a pound, how much meat will \$3 buy?

19. What will a 10-lb. turkey cost at $28¢$ per pound?

20. 3 boxes of berries cost $25¢$. What will 12 boxes cost?

21. When 7 boxes of crayons will last a school 5 months, how long will 28 boxes last?

23. Ten per cent of a ton of hay is how many pounds?

24. How many dozen are there in 4 gross of pencils?

25. How much butter fat is there in 200 lb. of milk when a test shows that 4% of it is butter fat?

26. When each step is 8 in. high, how many steps are needed to reach a platform 6 ft. high?

27. 250 lb. of salt will fill how many 5-lb. sacks?

28. What is 120% of 5 miles?

29. *Find the cost of:*

a. 64 lb. of pork at $12\frac{1}{2}¢$.
b. 600 boxes of berries at $8\frac{1}{3}¢$.
c. 96 gal. of molasses at $50¢$.
d. 16 doz. oranges at $37\frac{1}{2}¢$.
e. 54 yd. of matting at $33\frac{1}{3}¢$.
f. 48 lb. butter at $25¢$.

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g. 16 knives at $62\frac{1}{2}¢$.
h. 24 sleds at $87\frac{1}{2}¢$ apiece.
i. 80 lb. rice at $6\frac{1}{4}¢$.

30. A man spent 20% of his salary for rent, 10% for clothing, 5% for fuel and light, 25% for food, and 20% for other things. What per cent of his money did he spend? What per cent did he save? If he saved $400 a year, what was his salary?

31. How many bushels of beets will $12 buy at $33\frac{1}{3}¢$ a bushel?

32. $16 will rent a boat for how many hours at 16¢ an hour?

33. What change will be left from a $20 bill after paying for 12 hours' labor at $37\frac{1}{2}¢$ an hour?

34. At $16\frac{2}{3}¢$ a dozen, how many ears of corn will $2 buy?

35. A boy in Philadelphia buys papers at the rate of 3 papers for 4¢ and sells them at 2¢ apiece. He cannot compute his profit on one paper. Can you tell him what it is?

36. What is the area of a rectangle $5\frac{1}{4}$ inches by 4 inches?

37. What is the cost of a dozen tomato plants at the rate of 4 for 5 cents?

38. At 10¢ a dozen, how many sheets of sandpaper will 5¢ buy?

39. A clerk in a rubber store sold 5 oz. of dentist's rubber. The price was $5.80 per pound. To find the cost of 5 oz. the clerk divided $5.80 by five. How would you have found it?

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Written

Reduce to common fractions or mixed numbers:

1. .00125 2. .0875 3. 3.625 4. 4.032

Multiply and test your work:

5. .00375 by 400
6. 5.275 by 5000
7. 5.64 by .006
8. 35.005 by .008
9. 350.5 by 8.04
10. 34.05 by $\frac{1}{8}$
11. .000568 by 1.07
12. 4.32 by .15
13. .0316 by .58
14. .375 by 2.05

15. Four and twenty thousandths by twenty-six and nine tenths.

16. How much a ton do I pay for coal when .375 of a ton costs me $1.875?

17. At what rate per hour is a launch running when it goes 132.3 miles in 13.5 hours?

18. A farmer buys groceries, and sells farm produce to the grocer as follows:

Groceries.	*Farm Produce*
10 gal. oil at 25¢	25 lb. honey at 18¢
50 lb. sugar at 6½¢	40 bu. potatoes at 98¢
2 boxes soap at $4.25	½ T. hay at $18
3 dozen oranges at 40¢	20 doz. eggs at 35¢
5 gal. molasses at 80¢	7 bu. pears at $1.50
20 lb. coffee at 35¢	72 lb. smoked ham at $.23

In whose favor is the balance of this account, and how much is due him?

19. 10% of a man's income was paid for rent. If his rent was $15 a month, what was his income per year?

20. After using 70% of his month's wages, Jerry had $14.40 left. What were his month's wages?

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21. Charles Howe, jewelry merchant, sold to Mrs. James R. Hazzard $\frac{1}{2}$ doz. silver tablespoons at \$30 a dozen, one dozen silver table-forks at \$25 a dozen, one tea urn, \$15.50, one kitchen clock, \$2.00. Who is the debtor? The creditor?

Make out the bill and receipt it.

22. *a.* Supposing a cubic foot of ice to weigh $62\frac{1}{2}$ lb., what is the weight of a pile of ice 12′ by 10′ by 8′?

b. How many three-ton loads would it make?

c. If $17\frac{1}{2}\%$ of the ice melts in handling, how many pounds can customers receive from this pile of ice?

23. Amos sells vegetables for Mr. Robbins, the gardener, and is allowed to keep $12\frac{1}{2}\%$ of all the money he takes in. (*a*) If he earned \$3.41 in a week, what was the amount of his sales for that week? (*b*) How much did Mr. Robbins receive?

24. I bought 75% of a carload of sugar and sold $\frac{2}{5}$ of my share. What per cent of the carload did I sell?

25. 97% of the pupils of a school are present. If 21 are absent, how many pupils belong to the school?

26. Three days are what per cent of a week?

27. *Find the number of which:*

a. 72 is $5\frac{1}{7}\%$
b. 10.5 is $1\frac{10}{11}\%$
c. 24.64 is $39\frac{1}{5}\%$
d. 12.834 is $14\frac{2}{7}\%$
e. 1263 is $17\frac{1}{6}\%$
f. 701.4 is $4\frac{2}{3}\%$
g. 284.4 is $105\frac{1}{3}\%$
h. 5.775 is $116\frac{2}{3}\%$
i. .3155 is $90\frac{1}{7}\%$
j. .833 is $108\frac{2}{11}\%$

28. Mr. Fitch gained \$4.60 in selling a wagon. This was $6\frac{1}{4}\%$ of its cost. What was the cost of the wagon?

29. The average attendance in a school was 640 pupils. If this was $91\frac{3}{7}\%$ of the number registered in the school, how many were registered?

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ESTIMATING ANSWERS

1. In 1913 the mills at Coatesville sold a kind of steel at $2\frac{1}{2}¢$ a pound. In 1917, the same kind of steel brought $7\frac{1}{2}¢$ a pound. Estimate the per cent of increase.

Estimate, then find exactly the cost:

2. Of 600 lb. of green Jumbo peanuts at $10\frac{3}{4}¢$ a pound.

3. Of a 24-lb. carton of fancy roasted peanuts at $13¢$ a pound.

4. Of a 150-lb. bag of shelled pop corn at $6\frac{3}{4}¢$ a pound.

5. Of 50 bushels of charcoal put up in bags holding $2\frac{1}{2}$ bu. each, at $75¢$ a bag.

6. Of 3 bags of Brazil nuts, 170 lb. in a bag, at $12\frac{1}{2}¢$ a pound.

7. Of 9 bags of Grenoble walnuts, 110 lb. in a bag, at $16¢$ a pound.

8. Of 900 paper bags at $1.10 per M.

See how many problems you can make and solve from these facts:

9. Mr. Mullin of Johnson County, Ind., raised 60 acres of peas. The plowing, harrowing, and rolling cost $2 an acre, the other labor $4.13 an acre, and the seed $12 an acre. The crop of peas sold for $84.20 an acre, and the vines for $15 an acre. From the proceeds of each acre Mr. Mullin gave $10 to the church.

10. A young man worked in a bank during his three-months college vacation, receiving $65 a month for one half of the time and $70 a month for the other half. He bought a suit for $25 and a hat for $2.50, and used $6 a month for other expenses.

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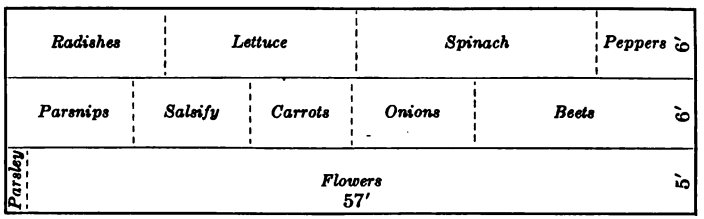
MAKING IT PAY

This record is taken from a city home garden. The entire family helped, and gained pleasure as well as profit.



Take your rule and find the scale of the plan.

1. How many square yards are there in this garden?
2. Find the total value of this garden produce:

Lettuce	70 heads	2 for 5 cents
Spinach	2 bu.	18¢ per pk.
Radishes	66 bunches	3 for 5 cents
Parsnips	40 lb.	5¢ per lb.
Salsify	25 bunches	5¢
Peppers	111	16¢ per doz.
Young onions	40 bunches	2 for 5 cents
Ripe onions	½ bu.	4¢ per qt.
Carrots	22 bunches	2 for 5 cents
Beets	30 bunches	2 for 5 cents
Beets (full grown)	3 pk.	60¢ per bu.

3. Adjoining this garden was a space devoted to fruit, flowers, and perennial vegetables.

Find the total value of the following:

Asparagus, averaging one bunch per day from May 1 to July 1 inclusive, at 9 cents a bunch.

Twenty bundles of rhubarb at 5 cents per bundle.

Three pounds of sage at 35 ¢ per pound.

Fifty-three baskets of grapes at 20 ¢ per basket.

Six and one half bushels of plums at 30 ¢ per peck.

Four bushels of cherries at 12 ¢ per quart.

Two bushels of pears at 40 ¢ per peck.

Two and one half bushels of peaches at 9 ¢ per quart.

Two bushels of currants at 12 ¢ per quart.

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PERCENTAGE PROBLEMS

1. Mr. Granger earns $1850 a year and saves 12% of it. How much does he save?

2. A teacher saves $135 a year, which is 15% of her salary. What is her yearly salary?

3. Mr. Smith pays $150 a year for fuel. That is what per cent of his salary of $3000?

4. A collector for a newspaper started out with bills amounting to $840. He collected $756. (*a*) What per cent of the bills did he collect? (*b*) What per cent did he fail to collect?

5. 35% of the apples in an orchard were unfit for market and could not be sold. If 1300 bushels were sold, what was the entire yield?

6. 39% of the 4700 blossoms on a cherry tree were blasted and the rest became fruit. How many cherries did the tree bear?

7. 98% of the men in a certain city can read and write. If there are 1398 men who cannot read and write, how many men are there in the city?

8. 23% of the men in a certain city work in factories. If there are 9200 men who work in factories, how many men are there in the city?

9. 45% of a jeweler's goods were stolen. (*a*) If he had $16,500 worth of goods left, what was the entire stock of goods worth? (*b*) How many dollars' worth were stolen?

10. In an orchard of 3600 trees, 25% were pear trees, 15% peach trees, 10% plum trees, and the rest apple trees. How many apple trees were there?

11. My gas bill for one month was $1.80. Five per cent of it was deducted for prompt payment. What was saved by paying promptly?

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PROBLEMS OF THE SEWING ROOM

1. Find the cost of an all-over apron in which these materials are used:

$4\frac{1}{2}$ yd. gingham, 12¢ per yard. Thread, 5¢.
2 bolts of trimming, 7¢ per bolt. Buttons, 2¢.

2. Find the cost of a cookery apron in which are used:

$1\frac{3}{4}$ yd. long cloth, 17¢ per yard.
1 bolt of rickrack, 5¢ per bolt.
3 buttons, 4¢ per dozen.

3. Find the cost of a middy blouse containing

2 yd. striped material, 14¢ per yard. Buttons, 6¢.
$\frac{1}{2}$ yd. plain material, 13¢ per yard. Thread, 5¢.

4. What is the cost of a sewing apron containing $\frac{3}{4}$ yd. of India linen, 16¢ per yard, and $2\frac{2}{3}$ yd. of lace, 3¢ per yard?

5. A high school girl made a hat. Find the cost of the following material, which she used:

1 frame, 10¢. $\frac{1}{4}$ yd. Suisine silk, 40¢ per yard.
$\frac{1}{8}$ yd. velvet, $1.00 per yard. 1 yd. gold braid, 10¢.

6. Make a form like this and fill in the spaces with store charges for materials, using quantities and prices indicated.

1 yd.	$12\frac{1}{2}$¢	75¢	$3.50
$\frac{1}{2}$ yd.			
$\frac{1}{3}$ yd.			
$\frac{1}{4}$ yd.			
$\frac{3}{4}$ yd.			
$\frac{5}{8}$ yd.			
$\frac{2}{3}$ yd.			
$\frac{7}{8}$ yd.			

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PROBLEMS WITHOUT NUMBERS

1. —— % of —— is what?

2. A merchant bought a dozen suits of clothing for $—— and sold them at $—— per suit. What did he gain on a suit? What did he gain in all? What per cent of the cost did he gain? What per cent of the selling price did he gain?

3. The diameter of a tree at its base is ——. This is —— % of its height. How tall is the tree?

4. A block of granite is —— ft. long, —— ft. wide, and —— inches thick. It contains how many cubic feet?

5. A box is —— in. long, —— in. wide, and —— in. deep. How many cubic feet of sand will it hold?

6. A rectangle is —— yards long. Its width is —— % of its length. What is its area?

7. Our schoolroom is —— ft. long and —— ft. wide. Its width is how many hundredths of its length?

8. The ages of the five boys in a class are —— yr., —— yr., —— yr., —— yr., and —— yr. What is the average age of the boys?

9. The volume of a water tank is —— cu. ft. How many gallons of water will it hold? (1 gal. = 231 cu. in.)

10. A church cost $——. The congregation has raised $—— toward paying for it. What per cent is still owing?

11. A cask contains —— gallons of vinegar. How many barrels of vinegar does it contain?

12. A merchant bought —— tons of sugar at —— per cwt. What did it cost? If he sold it at —— cents a pound, what was his gain on one ton?

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REVIEW OF PRINCIPLES AND PROCESSES

1. Moving a figure to the right affects its value how? To the left?

2. Annexing a cipher to an integer affects its value how? To a decimal?

3. How may a common fraction be reduced to a decimal? Why?

4. How may a decimal be reduced to a common fraction?

5. One factor has 2 decimal places, and the other factor has 3. How many decimal places in the product?

6. Can $\frac{3}{16}$ be reduced to an exact decimal? Why?

7. Can $\frac{2}{15}$ be reduced to an exact decimal? Give reason for answer.

8. Which term in division is always a product? Which terms in division are factors?

9. What does $25\frac{1}{2}\%$ mean?

10. When dividing to find the rate per cent, how must the number of decimal places in the dividend compare with the number of decimal places in the divisor? Why?

11. The first step in any percentage problem is the *Statement of the Problem.* Where do you look to find the Statement of the Problem?

12. Suppose you are to divide to find the rate per cent. The divisor contains two decimal places and the dividend one. What must you do first, and why? If the dividend contains two decimal places and the divisor two, what must you do first? If the dividend contains three decimal places and the divisor none?

13. The whole of any number is what per cent of it?

14. 300% of a number is how many times the number?

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QUICK MENTAL TEST

1. $.62\frac{1}{2}$ = what common fraction?
2. $.12\frac{1}{2}$ of \$56 = ?
3. $\frac{7}{8}$ of 1 ton is how many hundredths of 1 ton?
4. $.325 \times 100$ = ?
5. $62.8 \div 10$ = ?
6. 50% of what = 20 feet?
7. What per cent of a foot is 6 inches?
8. 60 dozen eggs at 25¢ a dozen cost how much?
9. \$10 will buy how much coffee at $33\frac{1}{3}$¢ a pound?
10. I have spent 10% of my money and have \$18 left. How much had I at first?

SHORT WRITTEN TESTS

I. *Multiply:*

1. 234.6 by .27
2. 32.40 by $.12\frac{1}{2}$
3. 560 by $.87\frac{1}{2}$
4. $2\frac{3}{8}$ by $4\frac{5}{19}$
5. 345 by $.16\frac{2}{3}$
6. 88.17 by 350

II. *Divide:*

1. .0488 by 3.05
2. .2752 by 8.6
3. 5.895 by .300
4. $31\frac{3}{7}$ by $60\frac{1}{2}$
5. $19\frac{3}{17}$ by $1\frac{8}{9}$

III. *Find:*

1. $17\frac{1}{2}$% of \$258.
2. What per cent of 50 days = 40 days.
3. 72% of how many square inches = 144 sq. in.
4. How much John weighed at 14 years if he weighed 85 lb. at 12 and gained 20% in two years.

IV. *Copy and add:*

1. $36.5 + 4.95 + 86.42 + 721.3 + 84.75 + .037 + 94.23$
2. \$420 + \$9.34 + \$.85 + \$162.07 + \$.15 + \$630.7
3. $433. + 8.96 + .076 + 8100. + 3.421 + 9.98 + 63.9$
4. $22\frac{1}{3} + 4\frac{2}{3} + 17\frac{5}{6} + \frac{3}{4} + 47.5$

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SIXTH GRADE

SECOND HALF

ORAL REVIEW QUESTIONS

(For class work, not for assignment.)

1. What number is composed of 5 units, 7 tens, and 3 thousands?

2. Read XLIV; CCLXII; DCXCI; MCMXIX.

3. *Give results rapidly, adding or subtracting the tens' figures first:* $36 + 45$; $29 + 32$; $57 + 76$; $93 + 28$; $93 - 27$; $84 - 45$; $72 + 39$.

4. *Give quickly the number of:*

a. Quarts in 98 pt.
b. Eggs in a crate containing 30 doz.
c. Hours in a week.
d. Seconds in 1 hour.
e. Inches in 2 yd.
f. Square inches in 2 sq. ft.
g. Square yards in 450 sq. ft.
h. Days in a summer.
i. Dimes in $15.
j. Feet in 2 rd.
k. Dollars in 36,000 cents.
l. Pints in 3 gallons.
m. Days in two common years.
n. Tons in 1600 lb.
o. Square rods in 10 A.

5. A half dollar, a quarter, 2 dimes, and a nickel are how many cents?

6. $\frac{1}{2} + \frac{1}{3} + \frac{5}{12} = ?$
7. $3 \times 8 \times ? = 48$
8. $8 \times 9 = 6 \times ?$
9. $88 \div ? = 8$
10. $15 - \frac{7}{8} = ?$
11. $18 - 1\frac{3}{5} = ?$
12. $5\frac{4}{5} + 13\frac{5}{5} = ?$
13. $7\frac{2}{3} - \frac{5}{6} = ?$

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WRITTEN REVIEW

1. Write in figures: forty-two thousand, and two hundred five ten-thousandths.

2. $209 \times 87{,}000$. (Test.)

3. $235{,}404 \div 468$. (Test.)

4. $23{,}945 \div 160$. (Test.)

5. $302{,}050 - 92{,}059$

6. 17 hr. 35 min. = how many minutes?

7. $639{,}800 \div 700$. (Test.)

8. $13.054 \div 42.8$

9. When 60 bu. of oats grow on an acre of ground, how many bushels grow on a square rod?

10. The ten highest batting averages in the National Baseball League in one year were .377, .363, .356, .328, .317, .316, .315, .311, .308, .304. What was the average of all these?

11. Using cancellation, divide $48 \times 54 \times 200$ by $18 \times 108 \times 25$.

12. How many pieces of sheeting, 39 yd. in a piece, worth 12¢ a yard, would pay for 52 hours' work for 36 men at 32¢ an hour? (Use cancellation.)

13. *Change to lowest terms:*

a. $\frac{240}{432}$ *b.* $\frac{357}{483}$ *c.* $\frac{54}{135}$ *d.* $\frac{34}{85}$ *e.* $\frac{72}{81}$ *f.* $\frac{48}{84}$

14. *Reduce to simplest form:*

a. $32\frac{24}{40}$ *b.* $\frac{322}{16}$ *c.* $\frac{236}{27}$ *d.* $\frac{136}{23}$ *e.* $\frac{527}{92}$

15. *Change to improper fractions:*

a. $43\frac{27}{32}$ *b.* $18\frac{3}{15}$ *c.* $56\frac{7}{15}$

16. *Change:* (*a*) $7\frac{3}{8}$ to 24ths. (*b*) $\frac{3}{8}$, $\frac{5}{6}$, and $\frac{7}{15}$ to fractions having the least common denominator.

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ORAL REVIEW QUESTIONS

1. $\frac{2}{3}$ of 8 = ?
2. $\frac{7}{8}$ of ? = 14
3. 27 is $\frac{9}{11}$ of what?
4. What part of 18 is 15?
5. 36 is $\frac{9}{10}$ of what?
6. $\frac{7}{8}$ of $\frac{16}{21}$ = ?
7. $\frac{5}{8}$ of what = 15 qt.?
8. $\frac{2}{3}$ of what = $\frac{4}{27}$?
9. How many 42ds are there in $\frac{3}{7}$?
10. What is the least number that exactly contains 6, 15, and 20?
11. What is the smallest number that 6, 8, 12, and 16 will divide?
12. *Give results at sight:*

a. 362 ÷ 10 *f.* 14 × 200 *k.* .06 of 500
b. 4900 ÷ 1000 *g.* .224 T. = —— lb. *l.* $\frac{1}{4}$ of —— = $7\frac{3}{4}$
c. 29 × .01 *h.* 99 ÷ .1 *m.* 5 % of 25
d. 834 ÷ 10,000 *i.* 23,400 ÷ 200 *n.* $12\frac{1}{2}$% of ——= 7
e. 29 × 1000 *j.* .12 × 50 *o.* $\frac{1}{16}$ = —— %

13. What per cent of a ton is 400 lb.?
14. Compare .84 × 25 with 84 × .25.
15. When 36 men can earn a sum of money in 15 da., how long will it take 12 men at the same wages to earn the same amount? 9 men? 6 men? 72 men?
16. If 6 men earn $8 in a certain time, how many men can earn $16 in the same time at the same rate? $32? $64? $4?
17. If 10 men earn $200 in 8 days, how much will twice as many men earn in that time at the same rate?
18. A circular chimney is 40 ft. high and the average diameter is 3 ft. What is the ratio of its height to its diameter?
19. A rectangular chimney is 36 ft. high. Its base is 2 ft. by 3 ft. What is the ratio of its height to the width of its base? To the length of its base?

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PROBLEMS OF WORK AND PLAY

1. Frances makes ice cream, using the following materials. Find the total cost.

2 eggs at 30¢ a dozen.
4 half-pint cups of milk at 10¢ a quart.
1 half-pint cup of cream at 50¢ a quart.
1 spoonful of vanilla extract, 1 cent.
¼ lb. sugar at 7¢ per pound.
10 lb. of ice at 60¢ per 100 lb.
2 lb. of salt at 60¢ for a 50-lb. sack.

2. The above recipe will make 1½ qt. of ice cream. How much would 3 qt. cost at the same rate?

3. Helen received a camera as a birthday gift, and learned to take pictures. She also received $2.50 with which to buy necessary materials for developing and printing. How much had she left after buying:

1 printing frame, 25¢
1 red candle lamp, 25¢
4 developing trays, 10¢ each
2 films, 20¢ each
2 packages printing paper, 15¢ a package
½ doz. developing powders, 50¢ a dozen
½ lb. acid fixing powder, 50¢ per pound

4. Helen made six pictures of Wilson and Sandy, using:

⅓ of 1 film
½ package of printing paper
1 developing powder
1 oz. acid fixing powder

What did they cost?

5. She could have made a dozen pictures with no additional expense except another half package of printing paper. How much apiece would the pictures have cost?

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STATEMENT OF THE PROBLEM

In solving problems 1–25, first write the statement of the problem; thus: $\frac{5}{8}$ of (price per ton) is \$4, etc.

1. If $\frac{5}{8}$ of a ton of coal costs \$4, what is the price per ton?

2. .025 of \$5600 is how much money?

3. A merchant sells cloth so as to gain \$.20 on a yard. This is .40 of the cost. Find the cost of a yard.

4. Joseph earned \$17, and used .62½ of it to help his mother pay the rent of her house. How much did he give toward the rent?

5. If Mary earned \$1.60 and gave her mother \$.40, what decimal part of her money did she give her mother?

6. A merchant sold cloth for cloaks at \$3.30 per yard. This was 1.65 times as much as it cost. What did it cost?

7. The list price of suits for a baseball team was \$4.75 apiece. The dealer sold 11 suits for .80 of the list price. How much did he receive for them?

8. An engineer who receives \$190 a month and spends \$95 a month saves how many hundredths of his earnings?

9. Monroe paid for chicken-feed .70 of all the money he received for eggs. If the chicken-feed cost \$35, what did he receive for eggs?

10. Two thirds of a carload of grain was lost in a wreck. If 450 bushels were lost, how many bushels were there in the carload?

11. Tom was absent from school two days in a year. If there were 200 days of school in the year, what per cent of the time did Tom lose?

12. A suit marked \$48 was sold late in the season for \$40. The reduction was what per cent of the marked price?

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13. By selling his automobile for $1860, Dr. Smith received .66⅔ of its cost. What did it cost?

14. .22$\frac{2}{11}$ of a rod is how many feet?

15. Lewis wants a bicycle. In 21 days he can earn .42 of the money with which to buy it. How many days must Lewis work in order to earn the bicycle?

16. Mr. Johnson's store caught fire, and his goods were damaged by smoke and water, so that he sold them for .35 of their cost. (*a*) What did he receive for 38 yd. of lace that cost $.25 a yard? (*b*) What was the cost of a coat that sold for $7? (*c*) How much did he lose on a table that cost $15?

17. .49 of a number is 19.6. (*a*) Find the number. (*b*) Find .62½ of the number.

18. $\frac{3}{11}$ of a certain number is 6⅕. Find .37 of the number. (How many statements?)

19. Mr. Byrne bought a house for $1200 and sold it for $1800. The gain was what decimal part of the cost?

20. 3 inches are how many hundredths of 3 feet?

21. I borrowed $250. When I paid it back, I paid my creditor $250 and .05 as much for the use of the money. How much did I pay in all?

22. The width of my garden is 48 feet, which is .80 of the length. Find the length.

23. Eldred sold his bicycle for $10.50, which was .35 of its cost. What did it cost?

24. There were 50 words in the spelling lesson and Charlotte missed two. How many hundredths of the words did she spell correctly?

25. Raymond shovels the snow from 80 feet of sidewalk. After shoveling .25 of the walk, how many feet more must he shovel?

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PER CENTS EQUIVALENT TO COMMON FRACTIONS

All percentage problems may be solved in decimals. But in many cases, as we shall see, the work may be shortened by changing the per cents to common fractions.

For example, if a merchant desires to sell goods at a discount in order to dispose of them, when the season is nearly over, he may sell them at a discount of 50%, or at $\frac{1}{2}$ price. Goods marked at \$4.00 would then sell for $\frac{1}{2}$ of \$4.00 or \$2.00. If he makes a discount of $33\frac{1}{3}\%$ from the marked price, he would deduct $\frac{1}{3}$ of the marked price. Goods marked \$1.50 would be sold at a reduction of $\frac{1}{3}$ of \$1.50, or \$.50 less than \$1.50. An article marked \$8 and sold at a discount of 25% would have $\frac{1}{4}$ of the marked price taken off, and would be sold for \$8 − \$2, or \$6.

Oral

1. The whole of anything is how many hundredths of it? What per cent of it?

2. $\frac{1}{2}$ of anything is how many hundredths of it? $\frac{1}{4}$? $\frac{1}{5}$? $\frac{1}{10}$? $\frac{3}{4}$? $\frac{2}{5}$? $\frac{3}{5}$? $\frac{1}{8}$? $\frac{3}{8}$? $\frac{7}{8}$? $\frac{2}{3}$? $\frac{1}{6}$? $\frac{1}{20}$?

3. What common fraction is the same as .10? .20? .30? .40? .50? .60? .70? .80? .90? .25? $.33\frac{1}{3}$? $.14\frac{2}{7}$? $.62\frac{1}{2}$? $.37\frac{1}{2}$? $.66\frac{2}{3}$? $.12\frac{1}{2}$? $.87\frac{1}{2}$? .75? $.16\frac{2}{3}$? .05?

4. What per cent is the same as $\frac{1}{2}$? $\frac{1}{3}$? $\frac{1}{4}$? $\frac{1}{5}$? $\frac{1}{6}$? $\frac{1}{7}$? $\frac{1}{8}$? $\frac{1}{10}$? $\frac{1}{12}$? $\frac{1}{20}$? $\frac{1}{16}$? $\frac{1}{25}$? $\frac{2}{3}$? $\frac{3}{4}$? $\frac{2}{5}$? $\frac{3}{5}$? $\frac{4}{5}$? $\frac{3}{8}$? $\frac{5}{8}$? $\frac{7}{8}$?

5. *Learn this table:*

$\frac{1}{2} = 50\%$	$\frac{1}{3} = 33\frac{1}{3}\%$	$\frac{7}{8} = 87\frac{1}{2}\%$
$\frac{1}{4} = 25\%$	$\frac{2}{3} = 66\frac{2}{3}\%$	$\frac{1}{10} = 10\%$
$\frac{3}{4} = 75\%$	$\frac{1}{6} = 16\frac{2}{3}\%$	$\frac{1}{12} = 8\frac{1}{3}\%$
$\frac{1}{5} = 20\%$	$\frac{1}{7} = 14\frac{2}{7}\%$	$\frac{1}{20} = 5\%$
$\frac{2}{5} = 40\%$	$\frac{1}{8} = 12\frac{1}{2}\%$	$\frac{1}{16} = 6\frac{1}{4}\%$
$\frac{3}{5} = 60\%$	$\frac{3}{8} = 37\frac{1}{2}\%$	$\frac{1}{25} = 4\%$
$\frac{4}{5} = 80\%$	$\frac{5}{8} = 62\frac{1}{2}\%$	

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Answer the following questions, using common fractions instead of decimals when it is easier to do so.

6. *Find:*

a. $33\frac{1}{3}\%$ of 12
b. 10% of 200
c. $16\frac{2}{3}\%$ of 30 da.
d. $8\frac{1}{3}\%$ of 144 sq. in.
e. 75% of 28 gal.
f. $66\frac{2}{3}\%$ of 27 cu. ft.

7. I saw straw hats in a window marked as follows: \$1.50, \$4.50, \$1.20, \$2.70, \$2.25. How much would be taken off from the price of each one if they were marked down $33\frac{1}{3}\%$?

8. Mr. Arnold raised 240 bushels of potatoes and saved $12\frac{1}{2}\%$ of them for seed. How many bushels did he save for seed?

9. Roger earned \$80, and put $87\frac{1}{2}\%$ of it in the bank. How much money did he put in the bank?

10. \$2 union suits are marked down 25%. At what price are they sold?

11. How much do I save on a \$30 overcoat by waiting until it is marked down $16\frac{2}{3}\%$?

12. What is the per cent of reduction when women's handbags, marked \$1.20, are sold at \$1.00?

13. What is the cost of a \$1.50 theater ticket including a war tax of 10%?

14. 80% of the people in a city of 95,000 population are native born. How many are foreign born?

15. Mr. Burns bought a house for \$4300, and paid 75% of it. How much was left unpaid?

16. Find the cost of one lower and one upper berth from Washington to Philadelphia, the lower costing \$ 2.00 and the upper 20% less.

17. How much is the 10% war tax on both tickets in question 16?

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MENTAL DRILL IN PERCENTAGE

(For class use, not for assignment.)

In the following exercises, first read the question as given, then repeat it, substituting the equivalent fraction for the rate per cent; thus: "20% of $\frac{5}{5}$ = $\frac{1}{5}$ of $\frac{5}{5}$, or ——. *Ans.*"

1. 20% of $\frac{5}{5}$
2. 40% of $100
3. 90% of $200
4. $62\frac{1}{2}$% of 24¢
5. $6\frac{1}{4}$% of 16 days
6. 60% of 50 ft.
7. $37\frac{1}{2}$% of 64
8. $87\frac{1}{2}$% of 96
9. $83\frac{1}{3}$% of 18 trees
10. $12\frac{1}{2}$% of 600
11. $33\frac{1}{3}$% of 60 years
12. 4% of $50
13. $8\frac{1}{3}$% of 3600 people
14. 25% of 836 miles

15. 9 is 25% of what number?
16. 32 is 50% of what number?
17. 75 is 10% of what number?
18. 4 is what per cent of 16? ($\frac{1}{4}$ = what per cent?)
19. 6 is what per cent of 9? ($\frac{6}{9}$ = $\frac{2}{3}$ = what per cent?)
20. 1 is what per cent of 16?
21. 3 months are what per cent of 18 months?
22. 3 books are what per cent of 15 books?
23. $7 are what per cent of $84?
24. 9 men are 75% of how many men?
25. 10 min. are $16\frac{2}{3}$% of what?
26. 2 is what per cent of 40?
27. 80% of 35¢ is what?
28. 20% of my money is 16¢. How much money have I?
29. 8 cents are $66\frac{2}{3}$% of what?
30. Each member of the class make a problem having a per cent equal to a common fraction.

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31. Arthur earned \$1.60 and paid 75% of it for a football. How much had he left?

32. In selling my watch I gained \$7. If that was $12\frac{1}{2}\%$ of the cost, what did it cost?

33. Out of 25 words, Charlie missed one. What per cent of the words did Charlie miss?

34. Edith had 9 examples right. If there were 10 in the lesson, what per cent of them did she have right?

35. $\frac{100}{100} - \frac{90}{100}$ = how many hundredths?

36. 100% − 90% = what per cent?

37. If I spend 90% of my money, what per cent have I left?

38. Having spent 90% of my money, I had \$2 left. How much money had I at first?

39. A grocer sold 90% of a barrel of sugar and had 35 lb. left. How many pounds did the barrel contain at first?

40. Hubert gave away 75% of his apples and had 6 left. How many had he at first?

41. Harry took a silver dollar to the store and bought 2 lb. of cheese at 26¢ a pound. On the way home he lost $12\frac{1}{2}\%$ of the change. How much money did he lose?

42. A boy sold $66\frac{2}{3}\%$ of his chickens and kept 20 chickens. What per cent of them did he keep? How many had he at first? How many did he sell?

43. Sarah answered correctly 80% of the questions that came to her and missed one. How many questions came to her? How many did she answer correctly?

44. 5 cents are $12\frac{1}{2}\%$ of what sum?

45. Frank paid $16\frac{2}{3}\%$ of his money for a book that cost \$.20. How much money had he?

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PROBLEMS IN PERCENTAGE

Written

1. A retail merchant bought from a wholesale merchant the following bill of goods. He paid 50% less than the list price. How much did he pay for the goods?

Name and Quantity of Goods	*List Price*
4 doz. 1-oz. boxes ruby rubber bands	$21.60 per doz.
5 doz. inkstands	2.00 per doz.
7 doz. memorandum books	.80 per doz.
2 typewriter desks	$57.00 each

2. The retail merchant sold the typewriter desks at a reduction of 10 per cent from the list price. What did he receive for the two desks?

3. He sold the rubber bands at list price; but 6 boxes spoiled before he could sell them. How much did he actually gain on the rubber bands?

4. He sold the memorandum books at 8¢ apiece. (*a*) How much did he gain on one dozen? (*b*) He gained what per cent of the cost? (*c*) He gained what per cent of the selling price?

5. A merchant bought a piece of cloth for $65 and sold it for 130% of its cost. What did he receive for it?

6. (*a*) In one season the Chicago baseball team won 92 games and lost 60. What per cent of all the games played did the team win? (*b*) The Boston team won 78 games and lost 74. What per cent of all the games did it lose? (*c*) The New York team played 149 games and won $47\frac{97}{149}\%$ of them. How many games did it lose?

7. By selling paper at 150% of its cost, a stationer receives 90 cents a package for it. What is the cost of a package of this paper?

8. Twelve pounds lawn seed contained $2\frac{1}{2}$ lb. of white clover seed. What per cent of the mixture was this?

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AVERAGES

1. Harold raised tomatoes. He sold 100 lb. that ripened early at 8¢ a pound. Later he sold 200 lb. at 5¢ a pound, and still later 400 lb. at 2¢ a pound. What was the average price received?

SOLUTION:

100 lb. at 8¢	brought	$ 8.00
200 lb. at 5¢	brought	10.00
400 lb. at 2¢	brought	8.00
700 lb.	brought	$26.00

$26.00 \div 700 = .03\frac{5}{7}$ $3\frac{5}{7}$¢, average price. *Ans.*

2. Mr. Boynton sold 6 calves at $10 each, and 4 at $12.50. To find the average price received, he added $10 and $12.50 and divided the sum by 2, obtaining $11.25. What mistake did he make? What was the average price?

3. The attendance of our class for 12 days last month was perfect (100%). For 3 days it was 94% and for 5 days 92%. What was the average per cent of attendance?

4. A high school graduate's wages for the first six months after leaving school were $40 a month; the next 12 months, $50 a month, and the next 24 months, $70 a month. What was his average monthly salary?

5. A boy who left school after completing the eighth grade worked the first six months for $20 a month; the next 12 months for $24 a month, and the next two years for $30 a month. What were his average monthly wages for the entire time?

6. What was the average cost per cwt. of the following mixture of cattle feed?

2 cwt. bran costing	$1.20 per cwt.
1 cwt. corn meal costing	1.50 per cwt.
$1\frac{1}{2}$ cwt. linseed meal costing	1.56 per cwt.
1 cwt. cottonseed meal costing	1.55 per cwt.

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PROBLEMS OF THE SHOPPER

(Without a pencil.)

Should the shopper verify the salesman's figures? Should the shopper carry a pencil and pad?

1. On Saturday morning Mrs. Gregg bought $1\frac{1}{2}$ lb. of sausage at 18¢ per pound and a roast weighing $4\frac{1}{2}$ lb. at 20¢ per pound. How much change should she receive from a $2.00 bill?

2. Mrs. French bought at special sale for $4.95 a remnant of serge containing $4\frac{1}{2}$ yd. that had been selling at $2.00 per yard. How much did she save by buying at a special sale rather than at the regular sale?

3. Mrs. French also bought for $3.00 a pair of shoes that had been marked $5. What per cent of the marked price had been taken off?

4. Mr. Gilbert bought a steak weighing 3 lb. and a leg of mutton weighing $6\frac{1}{2}$ lb. The price of each was 25¢ per pound. How much was his change from a $5 bill?

5. Frank worked eight weeks during vacation for $4.50 a week. Before school opened, he bought a suit for $13.75, a hat for $1.25, a pair of shoes for $3.50, and a suit of underwear for $1.50. How much was left from his summer's earnings?

6. Mr. Munro had used on his farm machinery a lubricating oil that cost him 50¢ a gallon. He found another kind that cost only 12¢ a gallon and was better to use. How much did he save on 20 gallons of oil by buying the cheaper kind?

7. My mother buys eggs in the country at 28¢ per dozen and has them delivered by parcel post. What does she pay for 5 doz. including nine cents postage?

8. If strictly fresh eggs cost 40¢ a dozen in the city store, what does she save by buying 5 doz. in the country?

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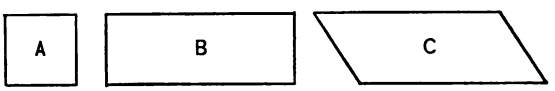
MEASUREMENT OF PARALLELOGRAMS

Lines that are the same distance apart throughout their whole length are **parallel lines**; *e.g.*

A four-sided figure whose opposite sides are parallel is a **parallelogram**; *e.g.*



Two lines that meet to form a right angle are **perpendicular to each other**; *e.g.*

The perpendicular distance from the highest point of a figure to the base, or to the base extended, is its **altitude**; *e.g.*

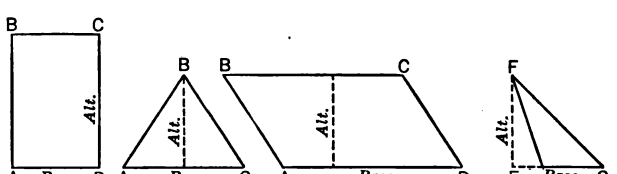


FIG. 1 FIG. 2 FIG. 3 FIG. 4

Figures are read by means of letters placed at their angles. Thus, Fig. 1 is read, "Oblong *ABCD*." Fig. 2 is read, "Triangle *ABC*." Read Figs. 3 and 4. The base of the triangle in Fig. 2 is *AC*. The altitude of Fig. 1 is *DC* or *AB*.

1. In Fig. 5 the part *K* compares how with the part *M*?

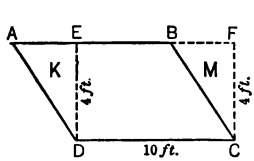


FIG. 5

2. The area of the parallelogram *ABCD* compares how with the area of the parallelogram *EFCD*?

3. What is the base of each of these parallelograms?

4. What is the altitude? What is the area?

5. Cut from paper different shaped parallelograms.

6. Change them to rectangular parallelograms by cutting off a part similar to *K* and placing it like *M*.

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How is the area of a rectangle found?

If the base of a rectangle is its length, the altitude is what?

If we know the base and altitude of a rectangle, how may we find the area?

Since any parallelogram may be made into a rectangle of the same base and altitude, how may we find the area of a parallelogram?

> *The area of a parallelogram is equal to the* **product** *of its* **base** *and* **altitude** *expressed in the same kind of units.*

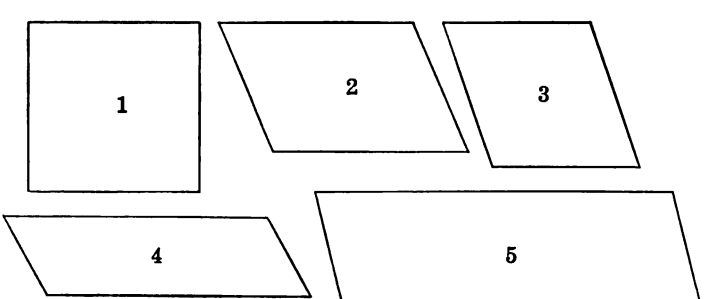
Oral

The following examples relate to parallelograms.

Fill in the missing number:

	Base	Alt.	Area		Base	Alt.	Area
1.	8 ft.	6 ft.	——	5.	——	30 in.	7 sq. in.
2.	$7\frac{1}{2}$ in.	8 in.	——	6.	2 ft.	6 in.	——
3.	5 mi.	——	4 sq. mi.	7.	$3\frac{3}{4}$ ft.	8 ft.	——
4.	——	6 yd.	96 sq. yd.	8.	——	1 yd.	15 sq. ft.

The following parallelograms are drawn to the scale of $\frac{1}{8}''$ to $1'$. Find their areas in square feet.



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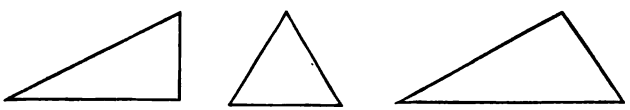
MEASUREMENT OF TRIANGLES

AREAS OF TRIANGLES

A plane figure bounded by three straight lines is a **triangle**; *e.g.*



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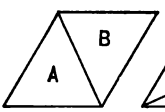

FIG. 1

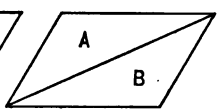

FIG. 2

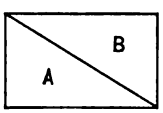

FIG. 3

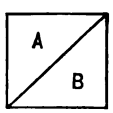

FIG. 4

1. Figures 1, 2, 3, and 4 are what kind of figures? What kind of figures are A and B?

2. In each of the above figures, how does A compare with B?

3. In each of the above figures, how do the base of the triangle and the base of the parallelogram compare?

How do the altitude of the parallelogram and of the triangle compare?

4. Fold a paper once. By cutting through both leaves of the paper at the same time, you may cut out two triangles. How do they compare? Put them together so as to make a parallelogram.

5. Repeat this process, cutting triangles, each pair of which differs in shape from the other pairs.

Each triangle is what part of the parallelogram having the same base and altitude?

6. How is the area of the parallelogram found? Of the triangle?

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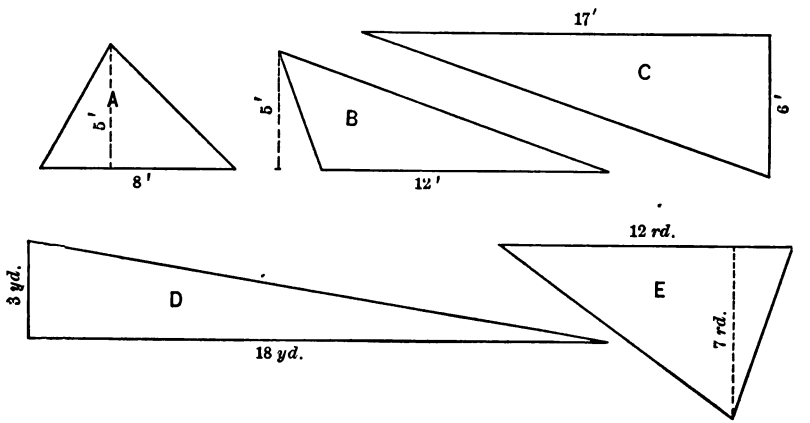
The area of a triangle is equal to **one half** *the* **product** *of its* **base** *and* **altitude**, *expressed in the same kind of units.*

7. The following triangles are drawn to a scale. The bases and altitudes of the triangles which they represent are indicated in the drawings. Find their areas.



Written

1. Find the areas of triangles having the following dimensions, using cancellation where possible. When the base and altitude are of different denominations, make them similar before multiplying.

	Base	Alt.		Base	Alt.
a.	51 ft.	42 ft.	*j.*	15 yd.	15 in.
b.	27 in.	15 in.	*k.*	2 mi.	160 rd.
c.	$6\frac{2}{3}$ ft.	$7\frac{1}{2}$ ft.	*l.*	$1\frac{1}{2}$ mi.	$120\frac{1}{2}$ rd.
d.	3 ft. 7 in.	2 ft. 9 in.	*m.*	4 rd.	$3\frac{1}{4}$ rd.
e.	$9\frac{3}{8}$ in.	16 in.	*n.*	2 yd.	50 in.
f.	18 yd.	27 in.	*o.*	$\frac{7}{11}$ rd.	12 ft.
g.	12 ft.	$5\frac{1}{8}$ yd.	*p.*	$10\frac{1}{2}$ yd.	5 ft. 4 in.
h.	14 rd.	7 yd.	*q.*	7 yd.	7 ft.
i.	1 mi.	80 rd.	*r.*	$17\frac{3}{4}$ in.	$\frac{2}{11}$ rd.

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MEASURING WOOD

The pile of wood in the center of this picture is 8 ft. long, 4 ft. wide, and 4 ft. high. How many cubic feet does it contain?

128 cubic feet = 1 cord.

In the forest, fuel wood for market is generally cut in 4-foot lengths like that in the picture, so that a pile 4 ft. high and 8 ft. long contains a cord of 128 cu. ft. The term *cord*, however, is often used to mean any pile of wood that is 8 ft. long and 4 ft. high, whatever may be the length of the sticks.

Hold your hand high enough to show the height of the pile of wood in the picture. Stand as many feet from the side of the room as the pile is long. Show with your hands the length of the sticks.

Written

1. A pile of 4-ft. wood 18 ft. long and $5\frac{1}{2}$ ft. high contains how many cords?

SOLUTION: $\frac{\overset{9}{\cancel{18}}}{1} \times \frac{11}{\cancel{2}} \times \frac{\cancel{4}}{1} \times \frac{1}{\underset{32}{\cancel{128}}} = \frac{99}{32} = 3\frac{3}{32}$ cords. *Ans.*

Using cancellation, find the number of cords in piles of 4-foot wood of the lengths and heights given below:

	LENGTH	HEIGHT		LENGTH	HEIGHT
1.	20 ft.	8 ft.	5.	40 ft.	4 ft.
2.	64	4	6.	72	7
3.	72	6	7.	18	2
4.	100	7	8.	26	5

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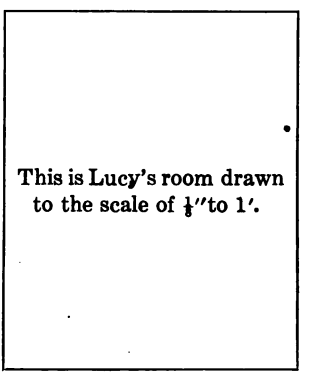
MEASURING SURFACES OF FLOORS AND WALLS

It is not worth while to consume time in elaborate computation to determine the quantity of paper needed for walls, or of carpet for floors. The exact quantity needed is impossible to determine before the work is done. One should, however, be able to measure approximately the surface to be covered and estimate roughly the quantity of material to be ordered.



This is Lucy's room drawn to the scale of $\frac{1}{8}$"to 1'.

1. What would a hardwood floor in this room cost at 18¢ per square foot?

2. How many square yards of floor are there?

3. How much will the carpet for this floor cost if the carpet is 1 yd. wide and costs $1.20 a yard?

4. The work of laying costs 5¢ a yard and carpet paper to lay under the carpet costs 5¢ a square yard. What is the entire expense of carpeting the room?

5. What would be the cost of cleaning this carpet at 8¢ per square yard?

6. What is the expense of covering a kitchen floor 12 ft. × 13½ ft. with inlaid linoleum at $1.40 per square yard, allowing 1½ sq. yd. for waste in matching the pattern?

7. Find the cost of covering a porch floor 9 ft. by 30 ft. with plain cocoa matting 54 in. wide at 50¢ a square yard.

8. The living-room of a summer cottage is 17 ft. × 24 ft., and the floor is covered with plain grass matting 1 yd. wide, laid without waste. (Which way must the strips run?) Find the cost at 40¢ a yard.

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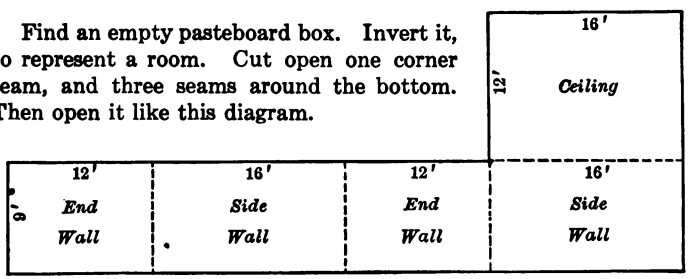
MEASURING WALL SURFACES

1. The scale of this drawing is $\frac{1}{16}'' = 1'$. Make a drawing like this, using $\frac{1}{8}''$ for $1'$. Cut it out and fold it on the dotted lines, making the model of a room.

Find an empty pasteboard box. Invert it, to represent a room. Cut open one corner seam, and three seams around the bottom. Then open it like this diagram.



2. What is the entire length of the end and side walls? What is the height?

3. How many square feet are there in all the walls?

4. How many square feet are there in the ceiling?

5. How many square feet are there in the walls and ceiling together?

6. How many square yards are there in all?

7. What will it cost to lath and plaster this room at 35¢ a square yard, taking out $5\frac{5}{9}$ sq. yd. for openings?

8. (*a*) What will it cost to lath and plaster a room 15′ by 18′ and 9′ high at $.30 a square yard, allowing 10 sq. yd. for doors and windows? (*b*) What will it cost at $.28 a square yard, making no allowances?

9. Measure your schoolroom to the nearest foot, and estimate the cost of lathing and plastering it at 50¢ a square yard. Allow 3 sq. yd. for each door and window.

10. Estimate the cost of plastering other rooms in your school building and in your own house.

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REVIEW AND PRACTICE

Oral

1. How many oranges will 50 cents buy at the rate of 3 for 10 cents?

2. $\frac{2}{3}$ of 18 is what part of 72? What per cent of 72?

3. What will 15 bu. of potatoes cost if $7\frac{1}{2}$ bu. cost $\$6\frac{1}{2}$? (15 is how many times $7\frac{1}{2}$?)

4. At \$15 a dozen, what will 84 chairs cost? (84 are how many dozen?)

5. 9 months are what part of a year?

6. I bought a peck of chestnuts for \$1.60 and sold them at 10 cents a half pint. How much did I gain? What per cent of the cost did I gain?

7. 25 is what part of 75? What per cent of 75?

8. Multiply 7.635 by 10; by 1000; by 100.

9. Divide 5.8 by 10; by 100; by 1000.

10. 36 lb. of coffee for \$9 is at the rate of 12 lb. for how much? (12 lb. are what part of 36 lb.?)

11. A wagon was sold for \$60, which was $\frac{4}{5}$ of the cost. What was the cost? How much was lost? What per cent of the cost was lost?

12. How much does Andrew make on 40 papers when he buys them at the rate of 4 for 3¢ and sells them at 2¢ apiece? (40 is how many times 4?)

13. What part of $\frac{1}{2}$ is $\frac{1}{4}$? $\frac{1}{8}$ is what part of $\frac{1}{3}$?

14. Find 20% of 300; $33\frac{1}{3}$% of 72; $16\frac{2}{3}$% of 60.

15. Sugar at \$140 a ton is how much a pound?

16. A house was damaged \$500 by fire. This was 10% of the cost. What was the cost?

17. $87\frac{1}{2}$% of the cost of Glen's bicycle was \$28. What was the whole cost?

18. If 9 eggs cost 27 cents, what will 2 doz. cost?

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Written

1. What will it cost to paint a ceiling 24 ft. long and $16\frac{1}{2}$ ft. wide, at 25 cents a square yard?

2. What is the length of one side of a square garden whose perimeter is 632 feet?

3. What will it cost at 65 cents a square yard to cover with matting a floor 21 ft. long and 15 ft. wide?

4. There are 5280 ft. in a mile. (*a*) If steel rails are 30 ft. long, how many are needed for 8 miles of street railroad track? (*b*) How many tons do they weigh if each foot weighs 90 lb.?

5. At the rate of 660 feet a minute, how many miles will a street car run in two hours? (Indicate and cancel.)

6. What is the cost, at \$1.80 per rod, of a fence inclosing a rectangular field 50 rd. by 34 rd.?

7. Draw a line to represent $1\frac{1}{2}$ miles, letting the scale be 1″ to 80 rd.

8. Draw a rectangular building lot 4 rd. by 8 rd., and put on the lot a house 44 ft. by 33 ft. and a barn 22 ft. square, using as a scale 1″ to 22′.

9. Three barrels of extract of witch hazel are put up in pint bottles and sold for 20¢ a bottle. What is received for all of it?

10. A grocer bought 40 bbl. of cider at \$3.50 a barrel, made it into vinegar, and sold it at 8¢ a quart. (*a*) How much did he gain? (*b*) What per cent of the cost did he gain?

11. Divide in the shortest way the product of 36, 40, 144, 8, and 160 by the product of 18, 272, and 6.

12. Mr. C. J. Hogan has laid for Mr. Henry Sumner a piece of Portland cement walk 50 ft. long and 5 ft. wide at $12\frac{1}{2}$¢ a square foot. Make out the bill and receipt it.

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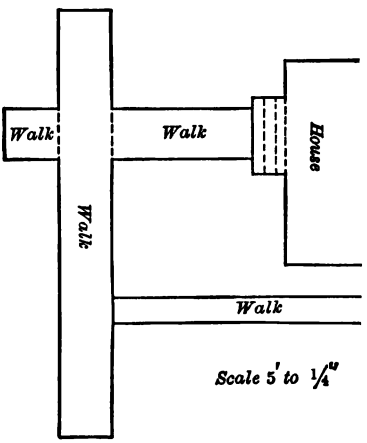
13. This walk is made of sawed Ohio sandstone. Find its cost at $21\frac{1}{2}¢$ per square foot.



14. A man owned $\frac{5}{8}$ of a mine and sold $\frac{3}{4}$ of his interest for $1710. What was the whole mine worth at the same rate? (STATEMENT OF THE PROBLEMS: $\frac{5}{8}$ of $\frac{3}{4}$ of (s. p.) = $1710.)

15. A teamster mixed 600 lb. of wheat bran with a ton of corn meal with which to feed his horses. (*a*) What per cent of the mixture was bran? (*b*) What per cent was corn meal?

16. The population of a city to-day is 130,000, which is 125% of what it was 10 years ago. What can you find? Find it.

17. Divide: (*a*) 8.8 by .0008; (*b*) 20.005 by .005.

18. Divide the sum of two thousand and two thousandths by two hundredths.

19. How many times will a bicycle wheel rotate in going a mile if the wheel is 7.2 ft. in circumference?

20. The product of two numbers is 12.46, and one of the numbers is 24.92. Find the other number.

Reduce to common fractions in lowest terms:

21. .025	**23.** $.06\frac{1}{4}$	**25.** .625	**27.** .21
22. .0125	**24.** $.87\frac{1}{2}$	**26.** .0875	**28.** .0495

Express as decimals:

29. $\frac{1}{40}$	**31.** $\frac{2}{125}$	**33.** $\frac{11}{125}$	**35.** $\frac{19}{200}$
30. $\frac{3}{16}$	**32.** $\frac{19}{20}$	**34.** $1\frac{3}{8}$	**36.** $1\frac{53}{500}$

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PROBLEMS IN PERCENTAGE

1. A hardware merchant bought a bill of goods for $560 and marked them to be sold at a price which was 140% of the cost. (*a*) At what price did he mark the goods? (*b*) He sold the goods for 90% of the marked price. What did he receive for them?

2. A jobber bought 2000 wheelbarrows at $2.25 apiece, marked them at 115% of their cost, and sold them for 95% of the marked price. What did he receive for them?

3. During a storm 1000 bbl. of sugar, or $8\frac{1}{3}\%$ of the cargo of a ship, were thrown overboard. How many barrels formed the cargo?

4. Make and solve a problem about $420 and 35%.

5. Mr. Fish paid city taxes to the amount of $280, which was $1\frac{4}{5}\%$ of the value of his property. How much was his property worth?

6. A load of boards weighing 3500 lb. was put into a kiln and dried. When taken out, the boards weighed $1\frac{1}{2}$ tons. What per cent of the weight of the boards at first was water?

7. (*a*) Write a problem in percentage in which factors are given to find a product. (*b*) Write another in which one of the factors is to be found.

8. If a pint of cream is used in making two gallons of ice cream, what per cent of the ice cream consists of other things than cream?

9. (*a*) If a pine plank weighs 45 lb. and an oak plank of the same size weighs 72 lb., the weight of the pine is what per cent of the weight of the oak? (*b*) The weight of the oak is what per cent of the weight of the pine?

10. A grocer bought 100 lb. of soda for $3.50 and sold it for $142\frac{6}{7}\%$ of its cost. What did he receive a pound for it?

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ARTICLES SOLD BY THE THOUSAND, HUNDRED, OR HUNDREDWEIGHT

Written

1. What is the cost of 8975 bricks at \$7 per M? (M stands for 1000.)

8975 = 8.975 M.

Since 1 M costs \$7, 8.975 M cost 8.975 × \$7, or \$——. *Ans.*

2. What must be paid for 980 pencils at \$2.30 per C? (C stands for 100.)

980 = 9.80 C.

Since 1 C costs \$2.30, 9.80 C will cost 9.80 × \$2.30, or \$——. *Ans.*

3. Find the cost of 1550 lb. of new buckwheat flour at \$3.50 per cwt.

1550 lb. = 15.50 cwt.

Since 1 cwt. costs \$3.50, 15.50 cwt. cost 15.50 × \$3.50, or \$——. *Ans.*

NOTE. — In final results, a fraction of a cent, equal to or greater than ½ cent, is counted a whole cent. A fraction which is less than ½ cent is dropped.

Find the cost of each of the following items and the total cost of all of them:

4. 27,325 bricks at \$8.15 per M.
5. 4900 cu. ft. of gas at \$1.20 per M.
6. 583 lb. sugar at \$6.75 per C.
7. 4900 tomato plants at \$4.50 per M.
8. 1000 laths at 40¢ per C.
9. 3125 cu. ft. of city water at \$.14 per C.
10. ½ T. fiber paper at \$4.50 per cwt.
11. 5600 paper bags at \$4.90 per M.
12. 16 boxes of envelopes, 250 in a box, at \$1.50 per M.
13. 850 Japanese napkins at \$.28 per C.

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LUMBER MEASURE

A piece of wood 1 ft. long, 1 ft. wide, and 1 in. thick is a **board foot** (bd. ft.).

TO THE TEACHER. — As material for this lesson, a real board foot — a piece of board exactly 1 ft. long, 1 ft. wide, and 1 in. thick — should be provided. Refer to it in obtaining answers to the oral questions below and whenever pupils seem to answer wide of the mark in this subject. This is very important.

Oral

1. How many inches long is a board foot? How many inches wide? How many cubic inches does a board foot contain?

2. How many board feet piled one upon another would make a cubic foot? Show with your hands how wide, long, and high this pile would be.

3. A board 1 in. thick, 1 ft. wide, and 6 ft. long contains how many board feet? Draw it full size on the blackboard, and mark off the board feet.

4. If the board in question 3 were twice as thick, how many board feet would it contain? How many inches thick would it be?

5. If it were five times as thick, how many board feet would it contain?

6. How many board feet are there in a piece of board 1 ft. wide, 16 ft. long, and 1 in. thick?

7. If this piece of lumber were 2 in. thick, how many board feet would it contain? 3 in.? 4 in.? 5 in.? 6 in.?

8. A piece of inch board 3 ft. long must be how wide to contain 1 bd. ft.?

9. A piece of board 1 in. thick, 2 in. wide, and 12 ft. long contains how many board feet?

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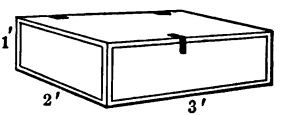
To find the number of board feet in any piece of lumber, multiply together its three dimensions, two *of them expressed* in feet *and the* other in inches.

Lumber less than 1″ thick is counted as 1″ thick in measuring.

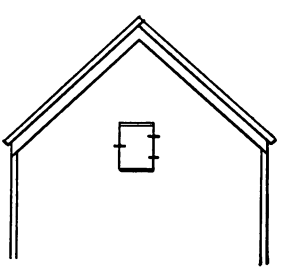
Oral



1. How much lumber is used in making this box with cover? (Take outside measurements.)

2. About how many feet of lumber (board feet) are there in the top of your desk? One end of the bookcase? The cupboard door? All the shelves in the bookcase?

3. Estimate the amount of lumber in a cubical box, including the cover, made of ½-inch lumber, the length of the box being three feet.



4. The door in this hayloft is $4\frac{1}{2}' \times 4'$. Two battens across the inside are $4' \times 6''$. How many feet of lumber are used in the door, the lumber being 1″ thick?

Written

1. What is the cost of 20 pieces of lumber $2'' \times 4'' \times 14'$ at \$60 per M?

SOLUTION. $\frac{20}{1} \times \frac{2}{1} \times \frac{4}{\cancel{8}} \times \frac{14}{1} \times \frac{1}{1000} \times \frac{\overset{20}{\cancel{60}}}{1} = \frac{11200}{1000} = \$11.20.$

Ans.

Find the cost of:

2. 18 pieces $1'' \times 6'' \times 16'$ at \$45 per M.

3. 48 pieces $2'' \times 4'' \times 18'$ at \$36 per M.

4. 88 pieces $3'' \times 4'' \times 14'$ at \$40 per M.

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	Number of Pieces	Dimensions	Price per M
5.	28	$2'' \times 6'' \times 16'$	$45
6.	96	$3'' \times 10'' \times 24'$	42
7.	29	$1'' \times 12'' \times 14'$	60
8.	90	$2'' \times 8'' \times 20'$	45
9.	50	$4'' \times 4'' \times 16'$	39
10.	16	$8'' \times 8'' \times 18'$	28
11.	128	$2\frac{1}{2}'' \times 12' \times 16'$	51
12.	44	$\frac{3}{4}'' \times 3'' \times 16'$	48
13.	28	$1\frac{1}{4}'' \times 4'' \times 12'$	63
14.	248	$\frac{3}{8}'' \times 2'' \times 16'$	110
15.	89	$\frac{7}{8}'' \times 3'' \times 12'$	41
16.	248	$1'' \times 6\frac{1}{2}' \times 16'$	40
17.	9	$6'' \times 10'' \times 20'$	32
18.	18	$8'' \times 12'' \times 30'$	40
19.	90	$4'' \times 10'' \times 30'$	40
20.	150	$\frac{7}{8}'' \times 10'' \times 14'$	62

(Problems 21–23 are for strong pupils.)

21. In making a chest, Fred uses two pieces of lumber $\frac{7}{8}'' \times 12'' \times 2\frac{1}{2}'$, two pieces $\frac{7}{8}' \times 12'' \times 16''$, four pieces $\frac{7}{8}'' \times 8\frac{7}{8}'' \times 31\frac{3}{4}''$, and one piece $\frac{1}{2}'' \times 1\frac{1}{2}'' \times 5\frac{1}{4}'$. Allowing 3 bd. feet for waste, how much lumber must Fred buy, and how much will it cost at $80 per M?

22. What must Mr. Allen pay for lumber to lay a new floor in his porch which measures 24 ft. by 10 ft.? The boards are $1\frac{1}{8}''$ thick. Mr. Allen adds an amount equal to $\frac{1}{3}$ of the entire floor, to allow for the loss in matching and for other wastes, and the lumber costs $58 per M.

23. Measure the floor of your schoolroom, and estimate the cost of lumber for a new floor $\frac{7}{8}''$ thick at $70 per M, adding $\frac{1}{4}$ of the actual surface, to allow for matching and other waste.

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REVIEW AND PRACTICE

(For class exercise, not for assignment.)

Oral

1. What common fraction in lowest terms equals $.33\frac{1}{3}$? $.87\frac{1}{2}$? .625? $.37\frac{1}{2}$? .20? .80? .60?

2. What decimal is equal to $\frac{3}{4}$? $\frac{1}{8}$? $\frac{2}{3}$? $\frac{3}{5}$?

3. Give results: $.8 \times 7$; $.12 \div 6$; $1.5 \times .6$; 1.03×5; $7.01 \times .6$.

4. Give results: $2000 \div 20$; 3.528×100; $53 \div 1000$; $950 \div 50$; 2.3×1000.

5. 10 is how many times $\frac{1}{4}$?

6. What is the cost of 24 oranges, when 8 oranges cost 25 cents?

7. What is the difference between $\frac{1}{4}$ of 10 and $\frac{1}{5}$ of 10?

8. If $2\frac{1}{2}$ yd. of cloth costs $\$7\frac{1}{5}$, what will 5 yd. cost?

9. $\frac{3}{5}$ of 20 are how many times 4?

10. $\frac{1}{3}$ is contained in 7 how many times?

11. Give results: $\frac{1}{2} - \frac{1}{3}$; $\frac{1}{4} - \frac{1}{8}$; $\frac{1}{3} - \frac{1}{6}$; $\frac{1}{8} + \frac{1}{2}$; $\frac{1}{5} + \frac{1}{3}$; $\frac{7}{9} + \frac{1}{3}$; $\frac{5}{14} \times \frac{7}{9}$.

12. What is the cost of three bananas at 20 cents a dozen?

13. How many boys are there in a class of 45 pupils if $\frac{5}{9}$ of the pupils are girls?

14. How many cubic feet of stone are there in a stone wall $8' \times 4' \times 2'$?

15. Ethel cut 20 roses one morning; 40% of them were red. How many red roses did she cut?

16. One dozen is what per cent of one gross?

17. A peddler sold 36 pencils at the rate of 2 for 5 cents. What did he receive?

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Written

1. *See how quickly you can obtain correct answers and test them:*

a. The addends are 4798; 6430; 895; 49,785; 231; 8942; 700; 98,346; 209; 98,020; 49; 816. Find the sum.

b. The product is 910,386, one factor is 4398. Find the other factor.

c. 7695 and 493 are the factors that make what number?

d. 2983, 4978, 9399, and 16,897 are the parts that make what number?

e. 83,469 added to what number will make 103,497?

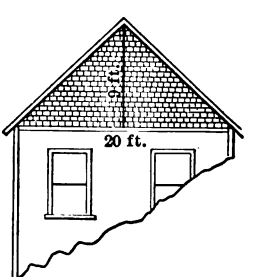
2. Mrs. Hill's new curtains cost $85.40. This was $\frac{2}{3}$ as much as her carpets cost. What was the cost of the carpets?

(STATEMENT: $\frac{2}{3}$ of (cost of carpet) is $85.40.)

3. *Find the areas of triangles having the following dimensions:*

a. Base 28 rd., alt. 46 rd.
b. Base 19 yd., alt. 23 yd.
c. Base 16 in., alt. 42 in.
d. Base 64 ft., alt. 47$\frac{1}{2}$ ft.

4. This gable is covered with shingles that cost $6.50 per M. If 8 shingles cover a square foot, what did the shingles cost?



5. What are the weekly wages of a girl who finishes 4800 buttonholes a day, if she receives 2$\frac{1}{4}$ cents per dozen garments, and each garment contains three buttonholes?

6. Reduce to common fractions in simplest form:

a. .025 *c.* .3125 *e.* .1275 *g.* .625
b. .375 *d.* .8375 *f.* .30 *h.* .475

7. Reduce $\frac{7}{320}$ to a decimal, and write the answer in words.

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PROBLEMS OF THE TYPEWRITER

1. In one year 648,000 typewriters were made in this country. If the average cost was $52.50 apiece, what did they all cost?

2. It required the work of 18,000 men to make these machines. How many machines were turned out per year for each man employed?

3. At that rate, how many men were needed to operate a factory that made 21,204 machines in a year?

4. What was the daily output of machines for this factory if it was in operation for 300 days?

5. If 36% of the cost of a machine goes for materials and the rest for labor, what is the labor expense for each machine? (See problem 1.)

6. If a typist receives $15 a week and writes 40 letters a day, what is the average cost of writing a letter?

7. Three girls aged 14 were in the 8th grade together. One studied stenography and typewriting as soon as she finished the 8th grade, the second after finishing the high school at 18, the third after finishing a college course at 22. The first began work at $8 a week when 15 years old, and was receiving $12 a week when 25 years old. The second began at $12 a week at 19 years of age and was receiving $20 a week when 25 years old The third began at $18 a week at 23 and was receiving $25 a week at 25. The first two rose no higher, but the third received $40 a week at the age of 35.

See how many problems you can make from these facts.

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PROBLEMS ABOUT BEE KEEPING

1. The owner of an apiary, or bee-village, in the city of Brooklyn began by buying the following articles:

1 colony of golden Italian bees in hive	$16.00
1 Italian queen	3.00
1 subscription to bee magazine	1.00
1 pair bee gloves	.75
1 bee veil	.50
1 smoker	.75
1 foundation fastener	.45
1 copy of the "A, B, C, and X, Y, Z, of Bee Culture"	2.60

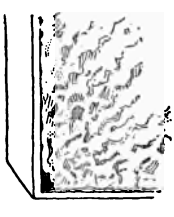
Having bought all these from one dealer, he obtained a discount of 10%. What did they cost him?

2. If 4500 bees weigh one pound, what is the weight of a colony of 50,000 bees?

DRONE

QUEEN

WORKER



HONEY FRAME

3. If a queen bee lays 1825 eggs in a day and 96% of them "hatch out" into young bees, a week's laying of eggs would produce how many young bees?

4. If there are 25 cells to a square inch of honeycomb, how many cells are there in a comb 3.8" by 3.8" in.?

5. Mr. Root has 48 colonies of bees. One half of them average for the season 26 sections of honey, which sells at $3.50 per case, 24 sections in a case. From the other half he obtains 75 lb. of extracted honey per colony, which he sells for 12¢ per lb. What is his income from the apiary?

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VACATION PROBLEMS

Henry was invited to his uncle's camp in the Adirondack Mountains for a two weeks' vacation and fishing trip. He had saved $20 from his earnings on Saturdays during the school year.

1. With a part of this money he purchased:
   1 Paragon bait rod, $2.50.
   1 multiplying reel, $1.40.
   1 enameled silk line, $.90.
   3 doz. snelled hooks at $.35 per dozen.
   1 canvas hook and tackle book, $.50.
   1 willow trout basket, $1.10.
   How much did these articles cost?

2. What was the amount of his railroad fare for 98 miles at $2\frac{1}{2}¢$ per mile?

3. He paid $.75 for a six-mile ride in a buckboard wagon from the station to his uncle's camp. Find the rate per mile.

4. Henry and his uncle went trout fishing eight times. Their catches for the different trips weighed as follows: 3 lb. 5 oz., 2 lb. 5 oz., 7 lb. 4 oz., 1 lb. 12 oz., 2 lb. 2 oz., 5 lb. 4 oz., 10 oz., 4 lb. 8 oz. What was the total weight? (Add the pounds and the ounces separately.)

5. If the weight of the trout averaged 7 oz. apiece, how many did they catch?

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PROBLEMS FROM THE WHEAT INDUSTRY

In two years the United States exported 231 million bushels of wheat.

1. In how many days would 1000 threshing machines thresh this wheat if each threshes 1375 bu. per day?

2. How many grain cars would carry this wheat if a car can carry 700 bushels?

3. If a bushel of wheat weighs 60 lb., how many tons would each carload weigh?

4. Allowing 33 ft. for the length of each car, a train must be how long to carry the entire quantity of wheat?

5. 48% of the yield of wheat in a western township in one year amounted to 73,728 bu. What was the entire yield of this township?

6. If the average yield was 20 bu. per acre, and 50% of the land was sown to wheat, how many acres of land were there in the township?

7. What was the value of the crop at $1.75 per bu.?

8. If it cost $4 to plow and sow an acre, $1.80 for seed, $.95 to reap and stack, and $3.00 to thresh, what did the farmer realize per acre for the use of his land?

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FROM THE FARM TO THE KITCHEN

1. Mr. Munro had 800 acres of wheat. One field of 200 acres yielded 25 bu. per acre; another field of 175 acres yielded 23 bu. per acre; and another of 160 acres yielded 40 bu. per acre. The remainder of the land yielded 26 bu. per acre. What was the average yield of the 800 acres? (Estimate it first.)

2. The Centennial Mill makes 600 bbl. of flour every 24 hours. In how many minutes is one barrel made?

3. When quarter-barrel sacks cost $52.50 per M, how many dollars' worth of sacks does the mill use in six days?

4. When 196 lb. of flour are made from 260 lb. of wheat, what per cent of the wheat becomes flour?

5. A bushel of wheat weighs 60 lb. (*a*) One kind of wheat is 12% gluten and another kind is 14% gluten. How many more pounds of gluten are there in a bushel of the second kind than in a bushel of the first kind? (*b*) If the first is 75% starch and the second is 71% starch, how many more pounds of starch are there in the first than in the second?

6. Fifteen pounds of farina are made from 60 lb. of wheat. What per cent of the wheat becomes farina?

7. A 2-lb. package of farina is sold for 35 cents. A 10-lb. sack of the same kind of farina is sold for 75 cents. How much more per pound is paid for the small package than for the large one?

8. From 440 lb. of oats, 180 lb. of rolled oats are made. 203 lb. go into "feed," and 57 lb. are lost. (*a*) What per cent of the grain becomes rolled oats? (*b*) Which is better, to buy a 2-lb. package of rolled oats for 38¢ or a 5-lb. package for 60¢?

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INTEREST

When we have the use of property belonging to another, we pay the owner for the privilege of using it. For instance, if Mr. A lives in a house that belongs to Mr. B, he pays Mr. B a certain sum for the use of the house. What is that sum called? The amount that Mr. A pays depends upon the value of the house and the length of time for which the rent is paid.

When you rent a boat at the boat livery, you pay for it according to the time you use it. Can you give other illustrations of paying for the use of property belonging to others?

Sometimes a man finds it necessary to borrow money from another. Can he return the exact pieces of money which he borrowed? Should he return just as much as he borrowed? Should he return more than he borrowed? Why?

The sum paid for the use of a large quantity of money should compare how with the sum paid for the use of a smaller quantity of money?

The sum paid for the use of some money for a long time should compare how with the sum paid for the use of the same money for a short time?

Money paid for the use of money is **interest.**

Money for the use of which interest is paid is the **principal.**

The sum of the principal and interest is the **amount.**

The sum to be paid for the use of money is always determined by taking a certain per cent of the principal.

The number of hundredths of the principal taken as the interest for one year is the **rate of interest.**

For instance, if a sum of money is borrowed and 6% of that sum is the interest for one year, the rate of interest is 6%.

The rate of interest which is fixed by law is called the **legal rate.**

In a majority of the states the legal rate is 6%. In some states it is greater than 6%, and in some states less.

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A lower rate than the legal rate is always allowed by law if the debtor and creditor so agree. In a few states a higher rate than the legal rate is allowed if the debtor and creditor so agree; but in most states a higher rate than the legal rate is forbidden by law. What is the legal rate where you live?

Interest at a higher rate than that permitted by law is **usury.**

Oral

1. Mr. Smith borrowed from Mr. Arnold $100 for 1 yr. At the end of the year Mr. Smith repaid the money which he had borrowed and also paid Mr. Arnold 6% interest. How much was the interest? What was the principal? How much did Mr. Arnold receive in all? What is this sum called? Who was the debtor? Who was the creditor?

2. What is the interest on $500 at 6% for 1 yr.? On $800? On $900? On $300? On $1000? On $250?

3. What is the interest on $500 for 1 yr. at 5%? At 10%? At 7%? At 4%? At 3%? At 8%?

4. What is the interest on $1000 at 5% for 1 yr.? For 2 yr.? For 3 yr.? For 8 yr.? For 10 yr.?

5. What is the interest on $100 for 2 yr. at 6%? At 4%? At 3%? At 9%? At 8%?

6. Six months are what part of a year? 3 mo.? 4 mo.? 8 mo.? 9 mo.? 10 mo.? 1 mo.?

7. What is the interest on $600 for 1 yr. at 6%? For 6 months? For 3 mo.? For 4 mo.? For 8 mo.? For 9 mo.? For 1 mo.? For 11 mo.?

8. What is the interest on $1200 for 1 yr. at 5%? For 1 mo.? For 2 mo.? For 6 mo.? For 7 mo.? For 10 mo.?

9. What is the interest on $300 for 1 yr. at 4%? For 7 yr.? For 1 mo.? For 8 mo.?

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NOTE. — Interest may be computed by many different methods. Bankers use an interest table, but people generally are not expected to carry interest tables in their pockets. Hence it is desirable that pupils should be taught some one method thoroughly. The advantages of the method given here are five, namely:

1. It may be used for any rate of interest.
2. It may be used for any kind of interest (common, exact, etc.).
3. It may be used for any interest period.
4. In most cases it is the shortest method, hence saves time and liability to error.
5. It always gives the exact result, since no fraction of a cent is dropped until the final division is performed.

Results by this method agree with the bankers' interest tables.

Other interest methods are given in the appendix to Part II.

Written

1. What is the interest on \$2000 for 3 yr. at 7%?

$$\frac{7}{\cancel{100}} \times \frac{\$2000}{1} \times \frac{3}{1} = \$420. \quad \textit{Ans.}$$

(How do we find the interest for 1 yr.? For 3 yr.?)

2. What must be paid for the use of \$700 for 4 mo. at 6% per year?

(4 mo. is what part of a year?)

$$\frac{\overset{2}{\cancel{6}}}{\cancel{100}} \times \frac{\$700}{1} \times \frac{1}{\cancel{3}} = \$14. \quad \textit{Ans.}$$

3. Find the interest on \$350 for 3 yr. 6 mo. at 4%.

(3 yr. 6 mo. = how many years?)

$$\frac{\overset{2}{\cancel{4}}}{\cancel{100}_{2}} \times \frac{\overset{7}{\$350}}{1} \times \frac{7}{\cancel{2}} = \$\text{——}. \quad \textit{Ans.}$$

4. *Find the interest on* \$800 *at* 6%:

a. For 7 yr. *b.* For $2\frac{1}{3}$ yr. *c.* For 9 mo.

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d. For 2 yr. 6 mo. *f.* For 5 mo. *h.* For 2 yr. 10 mo.
e. For 1 yr. 8 mo. *g.* For 1 yr. 5 mo. *i.* For 3 yr. 7 mo.

NOTE. — In final results, a part of a cent smaller than ½ cent is dropped; a fraction equal to, or greater than, ½ cent is called one cent.

5. *Find the interest on* \$1600 *at* 5%:

a. For 5 yr. *c.* For $2\frac{2}{3}$ yr. *e.* For 1 yr. 3 mo.
b. For $4\frac{1}{2}$ yr. *d.* For 3 yr. 8 mo. *f.* For 2 yr. 3 mo.

6. Find the interest on \$400 for 3 yr. at $3\frac{1}{2}\%$.

$$3\tfrac{1}{2}\% = \frac{3\frac{1}{2}}{100}, \text{ or } \frac{7}{200}$$

$$\frac{7}{\cancel{200}} \times \frac{\overset{2}{\cancel{\$400}}}{1} \times \frac{3}{1} = \$42. \quad \textit{Ans.}$$

7. *What is the interest:*

a. On \$200 for 4 yr. at 5%?
b. On \$1400 for 1 yr. at $4\frac{1}{2}\%$?
c. On \$1800 for 6 mo. at $6\frac{2}{3}\%$?
d. On \$1500 for 3 yr. 4 mo. at 4%?
e. On \$1200 for 2 yr. 8 mo. at $4\frac{1}{2}\%$?

It is the custom of business men in computing interest to consider one month as 30 days, and one year as 360 days.

Allowing 360 days for a year, 100 days are what part of a year? 200 da.? 150 da.? 10 da.? 75 da.? 90 da.?

1. What is the interest on \$720 at 6% for 100 da.?

$$\frac{6}{\cancel{100}} \times \frac{\overset{2}{\cancel{\$720}}}{1} \times \frac{\cancel{100}}{\cancel{360}} = \$12. \quad \textit{Ans.}$$

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2. *Find the interest on* \$720 *at* 6%:

a. For 200 da. *c*. For 10 da. *e*. For 90 da.
b. For 150 da. *d*. For 75 da. *f*. For 45 da.

3. *Compute the interest on* \$1800 *at* 4%:

a. For 200 da. *e*. For 45 da. *i*. For 33 da.
b. For 150 da. *f*. For 75 da. *j*. For 93 da.
c. For 90 da. *g*. For 110 da. *k*. For 66 da.
d. For 30 da. *h*. For 240 da. *l*. For 345 da.

4. Compute the interest on \$75 at 4% for 2 mo. 20 da. (2 mo. 20 da. = how many days? What part of a year?)

$$\frac{\cancel{4}}{\cancel{100}_{\cancel{4}}} \times \frac{\cancel{3}\,\$\cancel{75}}{1} \times \frac{2}{\cancel{360}_{\cancel{3}\;3}} = \$\tfrac{2}{3} = \$.66\tfrac{2}{3}. \quad \textit{Ans.}$$

5. *Find the interest on:*

a. \$280 for 3 mo. 10 da. at 3%.
b. \$375 for 7 mo. 9 da. at 8%.
c. \$500 for 11 mo. 6 da. at 9%.
d. \$450 for $5\frac{2}{3}$ mo. at 8%.
e. \$300 for 4 mo. 12 da. at $7\frac{1}{2}$%.

6. What is the interest on \$450 at 6% for 1 yr. 1 mo. 10 da.?

(1 yr. 1 mo. 10 da. = 360 da. + 30 da. + 10 da., or 400 da.)

$$\frac{6}{\cancel{100}_{\cancel{4}}} \times \frac{5\,\$\cancel{450}}{1} \times \frac{\cancel{4}}{\cancel{400}_{\cancel{360}\;\cancel{4}}} = \$30. \quad \textit{Ans.}$$

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7. *Compute the interest on:*

a. $300 for 1 yr. 5 mo. 12 da. at 5%.

b. $900 for 1 yr. 7 mo. 11 da. at 4%.

c. $360 for 1 yr. 2 mo. 7 da. at 7%.

d. $840 for 2 yr. 15 da. at 6%.

8. Compute the interest on $660 for 2 yr. 8 mo. at $7\frac{1}{2}\%$.

$$7\tfrac{1}{2}\% = \frac{7\frac{1}{2}}{100} = \frac{15}{200}$$

$$\frac{\cancel{15}^{\,5}}{\cancel{200}\,\cancel{100}} \times \frac{\cancel{\$660}^{\,3.30}}{1} \times \frac{\cancel{32}^{\,8}}{\cancel{12}\,\cancel{4}} = \$132. \quad \textit{Ans.}$$

NOTE. — We cancel 100, then divide 330 by 100 by pointing off two decimal places.

9. Find the interest on $75.25 at 8% for 20 da.

$$\frac{\cancel{8}^{\,2}}{\cancel{100}\,\cancel{4}} \times \frac{\cancel{\$75.25}^{\,3.01}}{1} \times \frac{\cancel{20}}{\cancel{360}\,\cancel{18}\,9} = \frac{3.01}{9} = \$.33. \quad \textit{Ans.}$$

10. *Compute the interest on:*

a. $485.50 for 1 yr. 3 mo. at 4%.

b. $125.50 for 1 yr. 4 mo. at $4\frac{1}{2}\%$.

c. $240 for 8 mo. 15 da. at $5\frac{1}{2}\%$.

d. $540 for 1 yr. 4 mo. 10 da. at 5%.

From the foregoing examples we observe that the interest on any sum of money, at any rate, for any time, is always the product of three factors. What are they?

In what denomination is the time expressed before multiplying to find the interest?

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Written

In examples 1–24 *compute the interest:*

	Principal	Rate	Time
1.	$4320	$3\frac{1}{2}\%$	2 yr. 6 mo.
2.	$720	5%	1 yr. 8 mo. 11 da.
3.	$1081.08	7%	6 mo. 20 da.
4.	$5000	$4\frac{1}{2}\%$	2 yr. 8 mo.
5.	$901.80	8%	1 yr. 24 da.
6.	$1236.48	$4\frac{1}{2}\%$	2 yr. 2 mo.
7.	$620.40	$5\frac{1}{2}\%$	1 yr. 3 mo. 10 da.
8.	$1275.30	9%	1 yr. 6 mo. 15 da.
9.	$1500	$6\frac{1}{2}\%$	2 yr. 9 mo.
10.	$270.27	6%	2 yr. 27 da.
11.	$396	10%	1 yr. 1 mo. 9 da.
12.	$444	4%	2 yr. 6 mo.
13.	$84.50	7%	2 yr. 5 mo. 12 da.
14.	$16.75	7%	7 mo. 17 da.
15.	$336	5%	15 da.
16.	$300.50	3%	1 yr. 2 mo. 15 da.
17.	$42.20	$4\frac{1}{2}\%$	1 yr. 16 da.
18.	$51.17	4%	9 mo. 29 da.
19.	$35.50	7%	1 yr. 5 mo. 20 da.
20.	$691.04	5%	1 mo. 3 da.
21.	$640.50	10%	10 mo. 26 da.
22.	$105.10	12%	48 da.
23.	$92.96	7%	4 mo. 3 da.
24.	$31.40	7%	273 da.

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REVIEW AND PRACTICE

Oral

1. Which is greater, $\frac{1}{2}$ or $\frac{1}{3}$? $\frac{1}{5}$ or $\frac{1}{8}$? $\frac{5}{7}$ or $\frac{5}{9}$? $\frac{3}{11}$ or $\frac{3}{14}$?

2. The "Lincoln Stars" won 5 games of baseball, with the following scores: 7, 8, 2, 9, 4. What was their average score?

3. Name five aliquot parts of one dollar.

4. How many packages of cereal at $\$.12\frac{1}{2}$ each can be bought for \$3?

5. What per cent of anything is $\frac{1}{2}$ of it? $\frac{1}{3}$ of it? $\frac{1}{4}$? $\frac{2}{3}$? $\frac{1}{8}$? $\frac{3}{4}$? $\frac{2}{5}$? $\frac{7}{8}$? $\frac{5}{8}$?

6. Annie owns a 100-dollar liberty bond that bears 4% interest. What is the interest for six months?

7. $62\frac{1}{2}\%$ of \$16 is how much money?

8. From the Fourth of July to Christmas is how many days?

9. What is the cost of 2500 shingles at \$6 per M?

10. What is the area of a triangle whose base is 20 inches and whose altitude is 1 foot?

11. What is the area of a triangle whose base is 12 feet and whose altitude is 24 feet?

12. How many feet of lumber are there in a board which is 14 ft. long, 6 in. wide, and $\frac{7}{8}$ in. thick?

13. What is the amount of \$300 for $1\frac{1}{2}$ yr. at 3%?

14. The interest on a sum of money for ten months is \$35. What is the interest on the same sum, at the same rate, for two months?

15. $\frac{1}{3}$ of a flagpole 126 ft. high was broken off by the wind. How many feet high was the piece left standing?

16. When Congress increased out-of-town letter postage from 2¢ to 3¢, what per cent was the increase?

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Written

In examples 1–4, add and test your work by adding in another order. Practice until you can get all answers correct in five minutes. For speed and accuracy, copy the numbers on the blackboard and add figures from left to right, putting down sums as rapidly as figures can be read with the eye.

1.	2.	3.	4.
358	26	98034	12843
47	544	576	798
968	37	934	6347
7684	829	86	999
9235	5444	715	3857
1386	308	8397	92124
428	9176	869	28315
79	283	476	76543
9830	706	59	89412
49	2493	987	6347
15730	819	43	48009
2132	6478	3754	90384

5. Express in Roman numerals the number of the year in which you were born.

6. Write in words 500,200.00202.

7. The sum of two numbers is 80,305. One of the addends is 79,496. Find the other.

8. One rectangular field is 35 rods by 54 rods; another is 24 rods by 51 rods. How many more feet of fence are required to inclose one of them than to inclose the other?

9. Mr. Welch sold two horses for $275 each, and a carriage for $295. He then bought an automobile costing $2\frac{3}{4}$ times as much as the horses and carriage brought. He received how much less than he paid out?

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10. 15% of the weight of a piece of cotton and wool cloth was wool. If the piece contained $25\frac{1}{2}$ lb. of cotton, how many pounds did the piece weigh?

11. In excavating the side of a hill for a railroad, it was necessary to remove 8500 cubic yards of clay and rock. If $19\frac{3}{4}$% of the material removed was rock, how many cubic feet of clay were removed?

12. *a.* A brick wall 41 ft. 6 in. long, 1 ft. 6 in. wide, and 8 ft. high contains how many bricks, if 22 bricks will make 1 cu. ft. of the wall?

b. They cost how much at $9.50 per M?

13. What is the interest on $350 for 7 mo. 15 da., the rate of interest being $5\frac{1}{2}$%?

14. Find in the shortest way the interest on a sum of money for 30 days, when the interest on the same sum, at the same rate, for 120 days, is $37.16.

15. The widths of six city lots, lying side by side, are as follows: 55 ft., 40 ft. 6 in., 72 ft. 9 in., 38 ft. 10 in., 80 ft., and 66 ft. 8 in. Find in feet the entire width of all the lots.

16. A grocer retails potatoes in baskets holding $\frac{5}{8}$ bu. each, at $1.25 a basket. What is the price per bushel?

17. Divide 23756.1 by 1.25.

18. Multiply 25.13 by 5.1.

19. The base of a triangle is 6 ft. Its altitude is 37.3 in. Find its area.

20. What is the interest on $900 for 1 yr. 24 da. at $4\frac{1}{2}$%?

21. $42.30 is the interest on how much money for 1 yr. at 6%? (First give the statement of the problem.)

22. Jessie Palmer packed 6 boxes of peaches with 60 peaches in a box, 10 boxes with 70 in a box, and 9 boxes with 84 in a box. What was the average number of peaches in a box?

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PROBLEMS OF THE SEWING ROOM

1. Needlebooks are made from pieces of white flannel 3″ by 4″, costing 50¢ a square yard. What do 30 such pieces cost?

2. A piece of Java canvas 4″ by $5\frac{1}{4}$″ is used for a needlebook. What does it cost at $1.00 per square yard?

3. A tea-holder is made from a piece of Java canvas $5\frac{1}{4}$″ by $5\frac{1}{4}$″, costing $1.00 per square yard, and a piece of sateen $5\frac{1}{2}$″ by $5\frac{1}{2}$″, costing 15¢ a square yard. What do both pieces cost?

4. Find the cost of the material for 30 cookery holders, each requiring a piece of gingham 8″ by $6\frac{1}{2}$″, another $6\frac{1}{2}$″ by $6\frac{1}{2}$″, and $\frac{1}{8}$ of a bolt of tape, the gingham being 27″ wide and costing 15¢ a yard, and the tape 4¢ a bolt?

5. How many pin wheels can be made from 2 yd. of cloth 32 in. wide if each pin wheel requires two pieces of cloth 4″ square?

6. Find the cost of 20 cookery holders, each requiring the following material:

2 pieces of unbleached muslin, $5\frac{1}{2}$″ × $5\frac{1}{2}$″, the muslin being 36 in. wide and costing $12\frac{1}{2}$¢ per yard; 1 piece of sheet cotton 5″ × 5″, a piece 72″ by 84″ costing $1.00; red thread, $.01; white thread, $.01.

7. A girl's skirt is made of muslin, 36 in. wide, at 20¢ a yard. It requires:

2 widths of muslin, 20 in. long

1 placket facing 2″ × 24″

$2\frac{1}{2}$ widths of cloth, $6\frac{1}{2}$″ wide (for ruffling)

What does the material cost?

8. Find the cost of material for a "middy" requiring: $2\frac{1}{2}$ yd. galatea at 18¢; $\frac{3}{4}$ yd. contrasting color for collar, belt, and cuffs, at 18¢; $\frac{1}{2}$ doz. buttons at 20¢, and spool of thread, 5¢.

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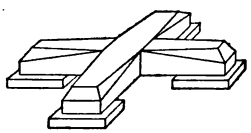
PROBLEMS OF THE SHOP

1. The two larger pieces in this flower-pot stand are $\frac{3}{4}'' \times 1\frac{1}{4}'' \times 7''$ and are cut from one piece $1'' \times 1\frac{1}{2}'' \times 16''$. How much of each dimension can be cut away in fitting the pieces to be put together?



2. After the pieces are made of the right size, the center of each piece is found, and lines are drawn across the stick at each side of the center and a distance from the center equal to one half the width of the piece. How far from the center are these lines drawn?

3. The wood is cut out between these lines halfway through the piece, to make a lap joint. How deep is the cut?

4. The lumber from which these pieces are made is what part of a board foot?

5. How many pieces $1'' \times 1\frac{1}{2}'' \times 16''$ can be cut from a board $1'' \times 9'' \times 16''$, making no allowance for the saw kerf?

6. What will such a board cost, at \$40 per M bd. ft.?

7. The smaller pieces, or feet, are square, and project $\frac{1}{4}''$ at each side and end of the crosspieces. What is the size of each foot?

8. The feet are $\frac{5}{16}''$ thick. What is the total height of the stand?

9. Forty of them piled one upon another would make a pile how many feet and inches high?

10. How many of these feet could be cut from a board $\frac{5}{16}'' \times 8'' \times 9\frac{1}{2}'$, allowing $\frac{1}{16}''$ for each saw kerf and $5\frac{3}{16}''$ for waste on account of season-checks at the ends?

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PROBLEMS OF HOUSEHOLD EXPENSE

1. Mrs. Edmonds has a budget of $65 a month for household expenses. During November she paid bills as follows:

For Electric Light	$1.90	For Coal	$8.25
For Gas	.83	For Dishes	1.20
For Help	8.40	For Box of Soap	4.15

Besides these expenditures, she supplied food for the table and had $3.14 left for an emergency fund. How much did the food cost?

2. In one year prices of food products varied as follows:

	March	June	September	December
Oranges	30¢ doz.	30¢ doz.	45¢ doz.	50¢ doz.
Eggs	28¢ doz.	28¢ doz.	40¢ doz.	55¢ doz.
Strawberries	40¢ box	10¢ box	40¢ box	50¢ box
Tomatoes	30¢ lb.	10¢ lb.	4¢ lb.	20¢ lb.
Asparagus	30¢ lb.	5¢ lb.	——	——
Green Corn	——	50¢ doz.	15¢ doz.	——

Mrs. Thoughtless bought 6 boxes of strawberries in December, 4 lb. of tomatoes in March, 3 doz. ears of corn in June, 6 dozen oranges in September, 5 lb. asparagus in March, and 4 doz. eggs in December. Mrs. Thrifty bought 6 boxes of strawberries in June, 4 lb. of tomatoes in September, 3 dozen ears of corn in September, 6 doz. oranges in March, 5 lb. asparagus in June, and 4 doz. eggs in March. How much did each pay for the same articles?

3. How much less would 6 doz. eggs cost in June than in December?

4. How much less does Mrs. Thrifty pay for twelve 49-lb. sacks of flour at an average price of $1.65 a sack than does Mrs. Thoughtless who buys forty-eight $12\frac{1}{4}$-lb. sacks at 50¢ a sack?

5. Make problems using prices in question 2.

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PROBLEMS WITHOUT NUMBERS

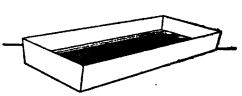
——% of the votes cast for congressman at a recent election were cast for Mr. Dill. If Mr. Dill received —— votes, how many votes were cast?

STATEMENT OF THE PROBLEM: ——% of (votes cast) were ——
or —— × votes cast = ——

SOLUTION: The number of votes cast for Mr. Dill divided by the number of hundredths indicated by the rate per cent equals the total number of votes cast.

2. A commission merchant received ——% of the selling price for selling —— tons of butter. If the butter sold at —— cents a pound, what was the commission man's fee?

3. An evaporating pan in a maple sugar camp is —— in. long, —— in. wide, and —— in. deep. How many gallons of sap will it hold?



4. My water bill for four months was ——. By prompt payment I secured a reduction of ——%. How much did I pay?

5. What is the area of a triangle whose base is —— ft. and whose altitude is —— ft.?

6. How many square yards of pavement will cover a street ½ mile long and 45 ft. wide between curbs?

7. A bushel of wheat weighs —— lb. If —— lb. of this weight is gluten, what per cent of the wheat is gluten?

8. Mr. Green employs —— men at $—— per day, —— men at $—— per day, and —— men at $—— per day. How much is Mr. Green's daily payroll?

9. Mr. Anderson has ——% of his money invested in real estate, ——% in notes, and the remainder, which is $——, in the bank. How much money has Mr. Anderson?

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REVIEW OF PRINCIPLES AND PROCESSES

1. A fraction always indicates what process?

2. What must be true of fractions in order that they may be added or subtracted?

3. How may a fraction be divided by another fraction?

4. How many decimal places are there in the product of two decimals?

5. When the divisor contains three decimal places and the dividend one, what should you do before dividing?

6. What number will divide every even number?

7. Why can an odd number never be exactly divided by an even number?

8. Interest is always the product of what factors?

9. When the product of two factors and one of the factors are known, how may the other factor be found?

10. When the product of three factors and two of the factors are known, how may the third factor be found?

11. Area is always the product of what dimensions?

12. Volume is always the product of what dimensions?

13. When one dimension is expressed in feet and another in inches, what should you do before multiplying to find area or volume?

14. How is the value of a decimal affected by moving the decimal point two places to the right?

15. How is the value of a decimal affected by moving the decimal point one place to the left?

16. Annexing a cipher to a decimal has what effect on the value of the decimal? Annexing a cipher to an integer?

17. What is the underlying principle of cancellation?

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QUICK MENTAL TEST

1. What is the interest on \$500 for 2 yr. at 6%?

2. The interest on \$300 for a certain time is \$25. Find the interest on \$1200 using the same time and rate.

3. 75% of one ton is how many hundredweight?

4. What per cent of a pound is 4 ounces?

5. $12\frac{1}{2}\%$ of an acre is how many square rods?

6. A boy who is idle 15 min. of every hour wastes what per cent of his time?

7. A man who earns \$6 a day and spends \$4 a day saves what part of his wages?

8. A train that runs 2 miles in 3 minutes runs how many miles an hour?

9. A grocer made a 10% discount on soap that was listed at \$4.00 a box. For what price per box did he sell it?

SHORT WRITTEN TESTS

I. *Find the quotients:*

1. $26.265 \div 3.09$ 2. $314.82 \div 3.18$ 3. $36.27 \div .0465$
4. $.6875 \div .08\frac{1}{3}$ 5. $.93\frac{5}{8} \div .02\frac{1}{2}$

II. *Find results:*

1. $\frac{2}{3}$ of $\frac{9}{14} \times 28 \div 3\frac{1}{2}$ 2. $8\frac{2}{3} - 1.5 + 9\frac{5}{6} - 3.6$
3. 16% of $4\frac{5}{8}$ 4. $12.493 - 5\frac{7}{8}$

III. *Find the interest:*

1. On \$347 for 5 yr. at $4\frac{1}{2}\%$.
2. On \$398.75 for 1 yr. 3 mo. at 8%.
3. On \$861 for 3 mo. 28 da. at 6%.
4. On \$2000 for 1 yr. 2 mo. 5 da. at 5%.
5. On \$3840 for 6 mo. 15 da. at $5\frac{1}{2}\%$.

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PRACTICE EXERCISES FOR ALL GRADES

Write answers on a slip of paper. Begin where the teacher directs, and see how many exercises you can complete in five minutes. (Two minutes, eight minutes, etc.) Time the class on single selected exercises. Keep records of time. How does the sixth grade time compare with fifth grade time? Anyone who makes a mistake is out of the game for that exercise.

Establish a reasonable time standard for your class and encourage every member of the class to practice each exercise until he reaches that standard. Study difficulties of individuals.

1. *Add:*

2	5	4	8	6	7	6	8	9	4
5	5	2	7	6	3	5	7	1	0
5	4	1	5	4	8	1	7	7	3

2. *Add:*

3	2	4	3	8	4	2	5	2	8
4	8	5	7	2	6	1	6	8	1
1	0	5	6	3	1	3	5	6	2
2	3	0	5	0	7	7	4	9	7

3. *Add:*

2	3	6	1	4	1	3	7	6	2
1	4	2	0	2	8	2	1	5	3
4	7	4	8	7	0	0	1	1	4
5	0	3	9	0	7	4	1	1	1
0	5	7	1	6	9	5	2	8	5

4. *Add:*

2	6	5	4	0	2	4	6	9	8
3	2	2	0	7	8	1	4	3	6
9	1	4	8	5	3	3	8	7	2
1	3	1	3	5	0	9	3	2	0
4	0	3	0	6	7	1	2	1	1
5	7	6	2	4	5	0	7	0	9

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5. *Add and subtract :*

21	38	42	50	60	82	48	79	89	91
6	7	9	7	9	7	5	6	9	3

Add :

6.	21	32	63	91	53	35	29	32
	46	57	25	18	42	44	60	55
7.	23	43	52	41	28	55	62	21
	62	71	36	37	31	34	35	38
8.	21	52	64	28	52	81	52	24
	34	25	35	40	36	29	43	63
9.	22	61	48	55	41	57	28	23
	42	37	31	22	23	42	61	42

Add, subtract, multiply :

10.	34	45	37	29	62	55	42	33
	6	2	8	4	8	7	6	5
11.	59	72	61	52	49	60	49	82
	4	8	9	3	5	7	5	6
12.	24	30	41	40	61	33	54	73
	8	6	9	9	7	6	8	6
13.	28	35	60	82	31	42	28	34
	4	7	8	9	5	6	5	7

Add : [METHOD: 35+28=35+20+8=63.]

14.	44	33	56	31	48	34	63	47
	29	74	25	49	57	18	78	29
15.	82	45	35	91	36	25	64	82
	19	38	43	28	49	38	79	41

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16.	45	76	93	38	68	29	34	72
	89	42	25	69	74	58	65	99

Add and subtract:

17.	86	49	33	57	81	68	41	92
	37	28	19	28	32	29	17	75
18.	81	91	83	51	36	52	65	73
	37	29	67	24	17	25	48	34

Add :

19.	4	2	4	2	0	8	1	0	2	3
	2	1	3	1	3	2	0	9	0	7
	1	8	0	6	2	1	7	8	8	5
	0	0	7	8	5	4	6	3	1	0
	7	9	5	1	9	4	1	2	9	7
	5	5	1	5	0	3	4	1	0	1
20.	2	9	0	5	8	3	9	8	2	8
	8	8	8	2	2	5	3	6	1	1
	1	2	3	0	1	8	1	1	3	0
	3	0	2	3	4	1	2	7	4	9
	4	1	1	7	7	0	3	4	5	2
	7	2	5	6	1	0	3	6	2	1
	6	3	4	9	6	7	9	8	7	8

21.	23		91		24		31		86		12	
	35		20		36		28		32		39	
	42		34		12		72		49		48	
	80		06		80		91		19		75	
22.	34		28		31		19		12		29	
	49		30		28		30		31		31	
	63		40		70		40		42		78	
	21		59		69		09		83		22	
	12		28		18		98		45		98	

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23.

28	71	38	18	68	66
39	28	90	39	24	45
47	34	12	40	59	83
65	42	81	86	83	29
49	29	96	59	71	81
83	06	19	28	62	60

Multiply :

24.

48	79	67	82	64	65	99	73
65	23	41	39	43	28	81	28

25.

85	89	54	77	39	51	29	49
76	43	68	49	24	86	75	86

26.

245	384	209	736	508
67	98	51	28	32

27.

479	409	249	907	512
88	37	35	68	37

28.

809	205	407	385	716
93	46	59	28	91

Divide :

29. $7\overline{)39}$ $7\overline{)64}$ $7\overline{)52}$ $7\overline{)49}$ $7\overline{)58}$ $7\overline{)44}$

30. $8\overline{)33}$ $8\overline{)43}$ $8\overline{)61}$ $8\overline{)38}$ $8\overline{)42}$ $8\overline{)69}$

31. $9\overline{)46}$ $9\overline{)38}$ $9\overline{)62}$ $9\overline{)73}$ $9\overline{)29}$ $9\overline{)44}$

32. $6\overline{)33}$ $5\overline{)28}$ $6\overline{)49}$ $4\overline{)37}$ $3\overline{)29}$ $6\overline{)44}$

33. $5\overline{)485}$ $7\overline{)742}$ $9\overline{)387}$ $7\overline{)133}$

34. $9\overline{)378}$ $8\overline{)392}$ $9\overline{)614}$ $8\overline{)632}$

35. $34\overline{)281}$ $26\overline{)475}$ $31\overline{)598}$ $73\overline{)460}$

36. $86\overline{)2493}$ $39\overline{)4257}$ $79\overline{)4865}$ $40\overline{)6935}$ $23\overline{)6479}$

37. $46\overline{)3946}$ $82\overline{)2793}$ $75\overline{)4834}$ $55\overline{)55055}$

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Add :

38. 4051	**39.** 5476	**40.** 6583	**41.** 4837
2038	830	793	698
6394	9746	448	8375
5243	798	2654	496
6897	8309	5987	3865
42. 3749	**43.** 8374	**44.** 2483	**45.** 3947
4056	2736	6407	8604
385	4374	9833	295
8374	5938	1295	38
496	6172	4685	9472
3872	4938	6427	6984

46. $\frac{1}{2}$ $\frac{3}{4}$ $\quad$ $\frac{2}{3}$ $\frac{3}{4}$ $\quad$ $\frac{1}{2}$ $\frac{2}{3}$ $\quad$ $\frac{1}{2}$ $\frac{5}{6}$ $\quad$ $\frac{1}{4}$ $\frac{7}{8}$ $\quad$ $\frac{1}{2}$ $\frac{3}{8}$ $\quad$ $\frac{5}{8}$ $\frac{3}{4}$ $\quad$ $\frac{7}{12}$ $\frac{2}{3}$

47. $\frac{1}{3}$ $\frac{1}{2}$ $\quad$ $\frac{2}{5}$ $\frac{1}{2}$ $\quad$ $\frac{3}{4}$ $\frac{7}{8}$ $\quad$ $\frac{6}{7}$ $\frac{1}{2}$ $\quad$ $\frac{1}{4}$ $\frac{5}{6}$ $\quad$ $\frac{7}{8}$ $\frac{1}{3}$ $\quad$ $\frac{2}{9}$ $\frac{2}{3}$ $\quad$ $\frac{1}{5}$ $\frac{5}{10}$

48. $\frac{3}{4}$ $\frac{7}{8}$ $\quad$ $\frac{2}{3}$ $\frac{5}{8}$ $\quad$ $\frac{2}{5}$ $\frac{9}{10}$ $\quad$ $\frac{5}{8}$ $\frac{1}{3}$ $\quad$ $\frac{4}{5}$ $\frac{2}{3}$ $\quad$ $\frac{1}{2}$ $\frac{5}{12}$ $\quad$ $\frac{3}{4}$ $\frac{1}{6}$ $\quad$ $\frac{2}{9}$ $\frac{1}{2}$

Subtract and multiply :

49. $\frac{3}{4}$ $\frac{1}{2}$ $\quad$ $\frac{3}{8}$ $\frac{1}{4}$ $\quad$ $\frac{5}{8}$ $\frac{1}{4}$ $\quad$ $\frac{7}{8}$ $\frac{5}{16}$ $\quad$ $\frac{3}{4}$ $\frac{1}{8}$ $\quad$ $\frac{1}{2}$ $\frac{1}{16}$ $\quad$ $\frac{1}{4}$ $\frac{1}{16}$ $\quad$ $\frac{1}{8}$ $\frac{1}{16}$

50. $\frac{5}{9}$ $\frac{1}{3}$ $\quad$ $\frac{8}{9}$ $\frac{2}{3}$ $\quad$ $\frac{2}{3}$ $\frac{1}{2}$ $\quad$ $\frac{3}{4}$ $\frac{2}{3}$ $\quad$ $\frac{5}{8}$ $\frac{1}{3}$ $\quad$ $\frac{7}{12}$ $\frac{1}{2}$ $\quad$ $\frac{5}{12}$ $\frac{1}{4}$ $\quad$ $\frac{11}{12}$ $\frac{3}{4}$

51. $\frac{4}{5}$ $\frac{1}{2}$ $\quad$ $\frac{3}{5}$ $\frac{1}{4}$ $\quad$ $\frac{1}{2}$ $\frac{1}{3}$ $\quad$ $\frac{1}{3}$ $\frac{1}{8}$ $\quad$ $\frac{2}{5}$ $\frac{1}{4}$ $\quad$ $\frac{5}{6}$ $\frac{1}{3}$ $\quad$ $\frac{1}{6}$ $\frac{1}{12}$ $\quad$ $\frac{5}{12}$ $\frac{1}{4}$

52. $\frac{3}{8}$ $\frac{1}{3}$ $\quad$ $\frac{4}{7}$ $\frac{1}{2}$ $\quad$ $\frac{5}{9}$ $\frac{1}{6}$ $\quad$ $1\frac{1}{2}$ $\frac{3}{4}$ $\quad$ $\frac{7}{9}$ $\frac{2}{3}$ $\quad$ $\frac{3}{4}$ $\frac{1}{6}$ $\quad$ $\frac{5}{8}$ $\frac{1}{3}$ $\quad$ $\frac{9}{10}$ $\frac{4}{5}$

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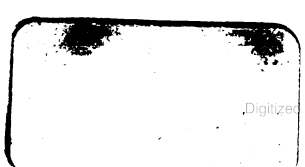

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